

The syntaxonomy of the mesophilous woods of the Central and Northern Apennines (Italy)

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Abstract

Here is presented a contribution towards the syntaxonomic definition of the mesophilous woods, mainly found throughout the montane and submontane bioclimatic belts, of the Central and Northern Apennines.

In the syntaxonomic groupings at the hierarchical level of alliance and suballiance, considerably modified with respect to previous reports, the contribution that the Eastern species makes to this vegetation is emphasised with reference to the syntaxonomic units with a Balkan distribution, bringing out the biogeographical connections that assign the territories under investigation to the Apennino-Balkan Province and to the Padanian and Apennine Subprovinces. Previously, these biogeographical links were shown in syntaxonomic terms only for the vegetation of the mixed deciduous woods, of the hilly bioclimatic belt, that have been assigned to the *Ostryo-Carpinion orientalis* alliance and included in the *Lauro-Quercenion pubescens* suballiance, for the mainly thermophilous, pre-Appennine woods rich in Mediterranean species, and *Laburno-Ostryenion carpinifoliae*, for those more mesophilous and inland. In the present study, also for the woods of the Central and Northern Apennines with a prevalence of beech, it is possible to show the link with the Eastern system assigning them to the *Artemonio-Fagion* alliance within which there is the new *Cardamino kitaibelii-Fagenion sylvaticae* suballiance. Furthermore, there is evidence of the co-presence in the Central Apennines of beech woods assigned to the southern Apennine *Geranio versicoloris-Fagion* alliance. This is due to a condition of altitude substitution causing the presence, at the lower altitude, of associations belonging to the latter alliance while impoverished forms of the Northern *Cardamino kitaibelii-Fagenion sylvaticae* suballiance occur solely at the higher altitudes.

Also for the woods of Turkey oak and European ash with the abundant presence of European hornbeam, the connection with the Eastern formation is proposed, assigning them to the *Erythronio dentis-canis-Carpinion betuli* alliance, for which can be found in Italy the *Asparago tenuifolii-Carpinenion betuli* suballiance for the Padanian Subprovince, and *Pulmonario apenninae-Carpinenion betuli* for that of the Apennines.

The syntaxonomical scheme for the communities discussed in the text and others meaningful for the studied area will be presented at the end of this document.

Key words: *Artemonio-Fagion*, biogeography, Central and Northern Apennines, *Erythronio-Carpinion*, Italy, phytosociology, syntaxonomy.

Riassunto

La sintassonomia dei boschi mesofili dell'Appennino centrale e settentrionale (Italia). Viene presentato un contributo per la definizione sintassonomica dei boschi mesofili, prevalentemente diffusi nei piani bioclimatici submontano e montano, dell'Appennino centro-settentrionale.

Nell'inquadramento sintassonomico a livello gerarchico di alleanza e suballeanza, notevolmente modificato rispetto ai precedenti lavori, viene enfatizzato il contributo delle specie orientali nella costituzione di questa vegetazione con il riferimento alle unità sintassonomiche a distribuzione balcanica, facendo emergere i collegamenti biogeografici che assegnano i territori di indagine alla provincia Appenninico-balcanica e alle subprovincie padana e appenninica. Tale collegamento biogeografico in precedenza è stato evidenziato in termini sintassonomici solamente per la vegetazione dei boschi misti di caducifoglie, del piano bioclimatico collinare, che sono stati riferiti all'alleanza *Ostryo-Carpinion orientalis* e inquadrati nelle suball. *Lauro-Quercenion pubescens*, per i boschi prevalentemente termofili, pre-appenninici, ricchi di specie mediterranee, e *Laburno-Ostryenion carpinifoliae*, per quelli più mesofili e interni. Con la presente ricerca si riconosce anche per i boschi dell'Appennino centro-settentrionale a prevalenza di faggio il legame con il sistema orientale riferendoli all'alleanza *Artemonio-Fagion* della quale si individua la nuova suballeanza *Cardamino kitaibelii-Fagenion sylvaticae*. Viene inoltre evidenziata la copresenza nell'Appennino centrale di fagete attribuibili all'alleanza appenninica meridionale del *Geranio versicoloris-Fagion* in quanto si determina una condizione di vicarianza altitudinale che porta alla presenza alle quote meno elevate di associazioni riferite a quest'ultima alleanza mentre esclusivamente sui settori sommitali si conservano forme impoverite della suballeanza settentrionale *Cardamino kitaibelii-Fagenion sylvaticae*.

Anche per i boschi a cerro e frassino maggiore, con rilevante presenza di carpino bianco, viene riproposto il legame con le formazioni orientali, attribuendoli all'alleanza *Erythronio dentis-canis-Carpinion betuli*, della quale in Italia si riconoscono le suballeanzi *Asparago tenuifolii-Carpinenion betuli*, per la subprovincia Padana e *Pulmonario apenninae-Carpinenion betuli* per quella Appenninica.

A conclusione del lavoro viene presentato lo schema sintassonomico delle comunità discusse nel testo e di altre che si ritengono significative per l'area indagata.

Parole chiave: Appennino centrale e settentrionale, *Artemonio-Fagion*, biogeografia, *Erythronio-Carpinion*, Italia, sintassonomia.

Introduction

The aim of this research is to make a further contribution towards the syntaxonomic definition of the mesophilous woods of the Apennines, with particular reference to the Central-Northern area, considering also the research collated at the European level, in particular from Germany, Austria and Slovenia (Pott, 1995;

Mucina & Grabherr, 1993; Marinček & Čarni, 2002) and Spain and Portugal (Rivas-Martinez *et al.*, 2001 and 2002), and with the aim of defining a general syntaxonomic scheme for Central-Western Europe (Biondi, Géhu, Pott & Rivas-Martinez, in progress).

The mesophilous woods of the Central Apennines, mainly found throughout the submontane and montane bioclimatic belts, have been the objects of many

phytosociological studies that have resulted in the description of a few associations that were reunited, at a higher hierarchical level, in the *Fagetalia sylvaticae* Pawłowski in Pawłowski, Sokolowski & Wallisch 1928 order and in the *Carpinion betuli* Issler 1926, *Tilio-Acerion* Klika 1955 and *Geranio nodosi-Fagion* Gentile 1974 alliances. The last of these alliances has since been reinterpreted and reduced to the level of the *Geranio nodosi-Fagenion* suballiance of the *Fagion sylvaticae* Luquet 1926 alliance. A substantially different proposal was put forward by Ubaldi *et al.* (1987) with the creation of an Apennine order *Lathyro veneti-Carpinetalia* within which were assigned the alliances *Laburno-Ostryon* Ubaldi 1981 of the Northern and Central Apennines, *Doronico-Fagion* Ubaldi *et al.* ex Ubaldi 1995 of the Southern Apennines and Sicily, and *Lathyrion veneti* Gamisans 1977 of Corsica.

Materials and Methods

Two matrices were prepared regarding respectively the woods with beech dominance and with European hornbeam and Turkey oak dominance. The first matrix was formed from 32 surveys of which 21 were unpublished and the others were from the calcareous territories of the Umbria-Marche Apennines (Ballelli & Biondi, 1982) and from the flysch-like territories of the

Tuscany-Marche-Romagna Apennines (Ubaldi & Speranza, 1985). The second matrix was formed from 63 surveys of which 39 were unpublished, and 24 were also from the Umbria-Marche and Tuscany-Marche-Romagna Apennines (Ubaldi & Speranza, 1982; Ubaldi, 1988; Catorci & Orsomando, 2001), to which there were added surveys from the North-Western Apennines (Oberdorfer & Hofmann, 1967) and from North-Eastern Italy (Poldini, 1985). The two matrices separately analysed by cluster analysis (Anderberg, 1973; Westoff & Van der Maarel, 1978) have allowed to obtain the dendograms on the basis of which the phytosociological tables have been ordered. Further tables have been realised from the surveys of the woods with a prevalence of European ash, from the ravine woods of sycamore, and another from the woods, also of the ravines, of hop hornbeam.

Results and Discussion

Beech woods

The analysis of the dendrogram shown in Fig. 1 demonstrates the presence of two main clusters which refer to the beech woods found throughout the calcareous substrata of the Central Umbria-Marche Apennines (cluster I) and to those found on the flysch-like substrata of the Central-Northern, Tuscany-Marche-Romagna

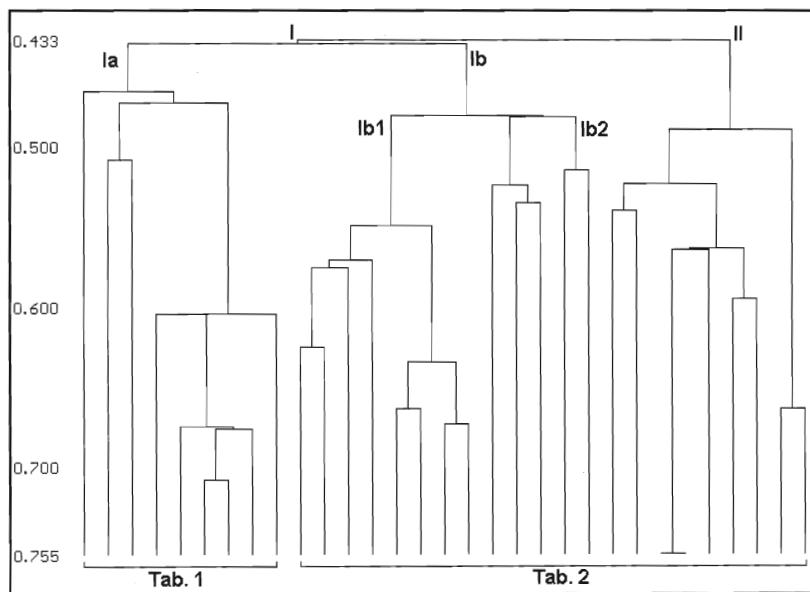


Fig. 1 - Dendrogram of the surveys of the beech woods of the Central Apennines. On calcareous substrata (I): *Cardamino kitaibelii-Fagetum sylvaticae* (Ia) and *Lathyro veneti-Fagetum sylvaticae* (Ib) in the subassociations *lathyretosum veneti* (Ib2) and *carpinetosum betuli* (Ib1). On flysch-like substrata (II): *Staphyleo pinnatae-Fagetum sylvaticae*

Apennines (cluster II).

The first cluster (I) can be subdivided into two sub-clusters: Ia within which there is the *Cardamino kitaibelii-Fagetum sylvaticae* association and Ib that corresponds to the *Lathyrō veneti-Fagetum sylvaticae* new association, which is in turn subdivided into the clusters corresponding to *carpinetosum betuli* (Ib1) and *lathyretosum veneti* (Ib2).

The second cluster (II) is made up of the surveys of the *Staphyleo pinnatae-Fagetum sylvaticae* association.

CARDAMINO KITAIBELII-FAGETUM SYLVATICAЕ

Ubaldi *et al.* ex Ubaldi 1995

(type rel. n. 3 of Tab. 6 in Ballelli & Biondi, 1982)

This association (Tab.1) includes the beech woods that grow at heights between around 1000m and the top of the calcareous heights or to the upper limits of the woods, that for this area of the Apennines was found at around 1850m. The association was described for Monte Catria and is present throughout a large part of the Central-Northern Apennine mountains at the heights indicated. Previously, all the lime beeches of this sector of Central Italy were assigned to the *Polysticho aculeati-Fagetum sylvaticae* association that was recognised as a later synonym of *Cardamino kitaibelii-Fagetum sylvaticae* (Biondi *et al.*, 2002). The characteristic and differential species of the association are: *Cardamine kitaibelii*, *C. enneaphyllos*, *Anemone nemorosa*, *Epilobium montanum*, *Polystichum aculeatum*, *Adoxa moschatellina* and *Taxus baccata*.

LATHYRO VENETI-FAGETUM SYLVATICAЕ ass. nova *LATHYRETOSUM VENETI* subass. nova

(type rel. n. 3 of Tab. 2) (rel. 1-6 of Tab. 2)

CARPINETOSUM BETULI subass. nova

(type rel. n. 7 of Tab. 2) (rel. 7-14 of Tab. 2)

Included in the new association are the beech woods found throughout on the calcareous substrata of the Central Apennines. These are generally monospecific coenosis, spread between around 600 and 1200m, depending on the exposure and on the steepness of the slopes. These woods represent the transitional aspect between the woods with a dominance of *Ostrya carpinifolia* of the *Scutellario columnae-Ostryetum carpinifoliae* association (*Laburno-Ostryenion* suballiance) and the beech woods present at the higher levels of the *Cardamino kitaibelii-Fagetum sylvaticae* association. The new association is characterised by the presence of plants of the hilly bioclimatic belt that are mixed with those that are typical of the montane one. The characteristic and differential species of the new association, in the *typicum* subassociation *lathyretosum veneti*, are: *Lathyrus venetus*,

Cyclamen hederifolium, *Sorbus aria*, *Viola alba* ssp. *dehnhardtii*, *Galanthus nivalis*, *Corydalis cava* and *Scilla bifolia*.

Also of note, there is the *carpinetosum betuli* subassociation that includes the woods with a prevalence of *Fagus sylvatica* with *Carpinus betulus* that still grow on the calcareous heights of the Apennine ridges, at heights between around 600 and 900m, with a subplain morphology, in the saddle areas with deep and well developed soils. In the arboreal layers, as well as the beech and the European hornbeam there is locally present *Quercus cerris*, while in the shrub layer, there are found *Acer campestre* and *A. obtusatum*. In the herbaceous layer, there are numerous nemoral species of the *Fagetalia sylvaticae* order. The differential species of the new subassociation are considered to be: *Carpinus betulus*, *Helleborus boissonei*, *Carex sylvatica* and *Veronica montana*.

STAPHYLEO PINNATAE-FAGETUM SYLVATICAЕ

Ubaldi & Speranza ex Ubaldi 1995

(type rel. n. 85 of Tab. 5 in Ubaldi & Speranza, 1985 – corresponding to rel. n. 20 of Tab. 2)

(rel. 15-23 of Tab. 2)

This association was described for the low mountain mixed beech woods present on the calcareous-marl flysch at heights between around 800 and 1100m on the Northern exposed slopes of the Tuscany-Marche-Romagna Apennines (Ubaldi & Speranza, 1985; Ubaldi, 1995). The characteristic and differential species of the association are: *Tilia platyphyllos*, *Staphylea pinnata*, *Pimpinella major*, *Euonymus latifolius*, *Lamiastrum galeobdolon* ssp. *flavidum*, *Cardamine heptaphylla*, *Milium effusum*, *Geranium nodosum*, *Acer pseudoplatanus*, *Asperula taurina*, *Bromus ramosus*, *Senecio fuchsii*, *Hordelymus europaeus*, *Anemone trifolia* ssp. *trifolia*, *Prenanthes purpurea*, *Acer platanoides* and *Lonicera caprifolium*. The association was assigned, by the authors that described it, to the *Euonymo-Fagenion sylvaticae* Ubaldi & Speranza 1985 suballiance, of the *Laburno-Ostryon carpinifoliae* Ubaldi ex Ubaldi 1995 alliance, of the *Lathyrō-Carpinetalia* Ubaldi *et al.* ex Ubaldi 1995 order (Ubaldi & Speranza, 1985).

DISCUSSION

The associations of beech woods described for the Northern and Central Apennines have been assigned to the Central European *Fagion sylvaticae* Luquet 1926 alliance (Hofmann, 1961; Gentile, 1974; Ubaldi & Speranza, 1985; Ferrari & Ubaldi, 1982; Credaro *et al.*,

Tab. 1 - *Cardamino kitaibelii-Fagetum sylvaticae* Ubaldi et al. ex Ubaldi 1995

Rel. n.	1	2	3	4	5	6	7	8	9	P
Altitude (m)	1060	1070	1000	1245	1285	1250	1255	1310	1282	r
Exposure	NNE	N	SE	SW	S	SE	SW	SSW	SSW	e
Slope (°)	40	45	30	26	30	28	25	28	25	s.
Coverage (%)	100	100	100	100	100	100	100	100	100	
Area (m ²)	300	250	200	200	200	200	200	200	200	
Charact. and diff. species of the ass.										
<i>Anemone nemorosa</i> L.	2.2	1.2	1.1	+	.	.	+	+	+	7
<i>Taxus baccata</i> L.	4.4	1.2	+	+	.2	+	+	.	.	7
<i>Cardamine enneaphyllos</i> (L.) Crantz	.	.	1.2	+	+	+	.	+	+	6
<i>Polystichum aculeatum</i> (L.) Roth	.	.	+	+	+	+	+	.	.	4
<i>Epilobium montanum</i> L.	.	+	+	+	.	.	+	.	.	2
<i>Adoxa moschatellina</i> L.	.	.	1.2	.	.	.	.	.	.	1
Charact. and diff. species of <i>Cardamino kitaibelii-Fagenion sylvaticae</i>										
<i>Geranium nodosum</i> L.	2.2	2.2	3.3	+	1.2	1.2	1.2	.2	1.2	9
<i>Adenostyles australis</i> (Ten.) Nyman	1.2	1.2	+	.	1.2	.2	+	+	.	7
<i>Cardamine kitaibelii</i> Becherer	.	1.2	1.1	.2	+	+	+	.	+	7
<i>Cardamine heptaphylla</i> (Vill.) O.Schulz	.	.	.	.	.	+	.2	+	+	4
<i>Dactylorhiza fuchsii</i> (Druce) Soó	+	1.2	.	.	.	.	.	.	.	2
<i>Pulmonaria appennina</i> Cristof. & Puppi	.	.	.2	.	.	.	.	.	.	1
Charact. and diff. species of <i>Aremonio -Fagion sylvaticae</i>										
<i>Saxifraga rotundifolia</i> L.	.	1.1	.2	+	+	.2	+	.	.	6
<i>Anemone ranunculoides</i> L.	.	.	1.1	+	.	.	.	.	+	3
<i>Anemone trifolia</i> L. ssp. <i>trifolia</i>	.	.	.	.	.	.	.	.2	.	1
<i>Ruscus hypoglossum</i> L.	.2	.	.	.	.	.	.	.	.	1
<i>Ranunculus lanuginosus</i> L.	.	.	.	.	.2	.	.	.	.	1
Charact. species of <i>Fagetalia sylvaticae</i>										
<i>Fagus sylvatica</i> L.	5.5	5.5	5.5	3.3	3.3	3.3	3.3	3.3	3.3	9
<i>Sanicula europaea</i> L.	3.3	2.2	2.2	.2	1.2	1.2	2.2	+	.	8
<i>Cardamine bulbifera</i> (L.) Crantz	1.2	+	+	+	.	+	+	.	+	7
<i>Polystichum setiferum</i> (Forsskal) Woynar	1.2	.	+	+	+	+	+	.	+	7
<i>Galium odoratum</i> (L.) Scop.	.	2.2	+	.	1.2	.	.2	+	1.2	6
<i>Festuca heterophylla</i> Lam.	1.2	1.2	1.1	.2	.	.2	.	+	.	6
<i>Lilium martagon</i> L.	1.1	.	.	+	+	+	+	.	.	5
<i>Arum maculatum</i> L.	+	.	.	.	.	+	.	+	+	4
<i>Rosa arvensis</i> Hudson	.	.	.	.	.	+	+	+	+	4
<i>Euphorbia amygdaloides</i> L.	+	.	.	.	.	.	+	.	+	3
<i>Dryopteris filix-mas</i> (L.) Schott	.	1.2	.	+	+	.	.	.	.	3
<i>Euphorbia dulcis</i> L.	.	+	+	.	.	.	.	.	.	2
<i>Allium ursinum</i> L.	2.2	.	.	1.2	.	.	.	.	.	2
<i>Stellaria holostea</i> L.	.	.	.	+	.	.	+	.	.	2
Charact. species of <i>Querco-Fagetea</i>										
<i>Daphne laureola</i> L.	+	+	.2	.2	+	.2	1.2	+	+	9
<i>Viola reichenbachiana</i> Jordan ex Boreau	1.1	.2	.2	.2	.2	+	.	+	.2	8
<i>Primula vulgaris</i> Hudson	+	.	.	+	.2	.2	.2	+	+	7
<i>Hepatica nobilis</i> Miller	+	.2	.2	.2	.2	.2	.	+	.	7
<i>Mycelis muralis</i> (L.) Dumort.	.	+	+	+	+	.	.	.	+	5
<i>Ilex aquifolium</i> L.	1.2	2.2	1.1	.	.	.	+	.	.	4
<i>Hedera helix</i> L.	1.2	.2	1.2	.	.	.	.	.	.	3
<i>Ajuga reptans</i> L.	.	+	.	.	+	.	.	+	.	3
<i>Campanula trachelium</i> L.	.	1.1	.	+	.	.	.	.	.	2
<i>Solidago virgaurea</i> L.	1.1	1.1	.	.	.	.	.	.	.	2
<i>Hieracium sylvaticum</i> (L.) L.	+	.	1.1	.	.	.	.	.	.	2
<i>Symphytum tuberosum</i> L.	+	.	+	.	.	.	.	.	.	2
<i>Cephalanthera longifolia</i> (Hudson) Fritsch	.	.	.	+	+	.	.	.	.	2
Other species										
<i>Rubus hirtus</i> W. et K.	.	.	.2	+	.2	.2	1.2	+	.2	7
<i>Fragaria vesca</i> L.	.	+	.	+	+	+	+	+	+	6
<i>Crataegus monogyna</i> Jacq.	.	.	.	+	+	+	+	+	.	4
<i>Geranium robertianum</i> L.	.	.	.2	+	.	+	+	.	.	4
<i>Geum urbanum</i> L.	.	+	.	.	.	.	+	.	+	3
<i>Senecio fuchsii</i> Gmelin	.	+	.	.	.2	.	.	.	.	2
Accidental species	4	12	8	3	1	-	3	-	1	

1980; Feoli & Lagonegro, 1982; Ballelli & Biondi, 1982) or to the Central-Northern Apennine *Geranio nodosum-Fagion* alliance (Gentile, 1969 and 1974) that has since been reduced to the level of a suballiance (Ubaldi & Speranza, 1985).

From an analysis of Tab. 1, it can be seen that the plants associated with the beech woods in the Apennine territories under consideration notably include the presence of species with a South-East European and European-Caucasian distribution which bring these beech woods close to those described for East-Balkan Europe and therefore of the *Aremonio-Fagion* alliance. In a recent syntaxonomical revision based on the floristic-ecological meaning of the beech forests of Southern Central Europe, this alliance is put in synonymy with the *Asperulo-Fagion* Tüxen 1955 alliance (Willner, 2002). On the contrary, we think that the syntaxa above association level should have a prevalent biogeographical meaning, in accordance with previous published reports for Northern-Eastern Italy (Poldini & Vidali, 1995) and in part for Central Alps (Cerabolini, *in verbis*). The *Aremonio-Fagion* alliance is divided into four suballiances (Marinček *et al.*, 1993): *Epimedio-Fagenion* Marinček *et al.* 1993 that groups the Illyrian mesophilous and subthermophilous woods; *Lamio orvalae-Fagenion* Borhidi ex Marinček *et al.* 1993 that groups the association of the mesophilous beech woods of the Central mountains of the Illyrian region and constitutes the type of the alliance, *Saxifrago rotundifoliae-Fagenion* Marinček, Poldini and Zupančič ex Marinček *et al.* 1993 to which belong the Illyrian high montane to subalpine belt beech woods and finally, *Ostryo-Fagenion* Borhidi 1963 which groups together the Illyrian continental thermophilous, paraMediterranean zonal and azonal woods. According to the proposal that is here advanced, the new *Cardamino kitaibelii-Fagenion sylvaticae* suballiance completes the distribution pattern of the *Aremonio-Fagion* alliance, with which a major part of the Padanian Subprovince, of the Apennino-Balkan province, and of the heights of the Apennine Subprovince to the calcareous heights of the Abruzzo Apennines are covered (Biondi *et al.*, 2002). This new suballiance, is characterized by a large number of floristic species: *Cardamine kitaibelii*, *C. heptaphylla*, *C. enneaphyllos*, *Trochiscanthes nodiflora*, *Phyteuma ovatum*, *Valeriana tripteris*, *Geranium nodosum*, *Adenostyles australis*, *Sorbus aucuparia*, *Daphne mezereum* and *Luzula nivea*.

The type association of the *Cardamino kitaibelii-Fagenion sylvaticae* suballiance is: *Cardamino kitaibelii-Fagetum sylvaticae*.

The new suballiance, south of the Emilia Apennines,

loses a good part of its floristic differential elements and therefore become a relic in the heights of the Umbria-Marche and Abruzzo Apennines.

In these Apennine areas there is the main friction area with the Southern Apennine *Geranio versicoloris-Fagion* alliance, which has recently been found also in Greece (Bergmeier & Dimopoulos, 2001), and in the territory of which can also be found the following characteristic and differential species: *Lathyrus venetus*, *Cyclamen hederifolium*, *Helleborus bockonei*, *Daphne laureola*, *Acer obtusatum*, *Pulmonaria apennina*, *Ranunculus lanuginosus*. In the area under study, this alliance is found with the associations *Lathyro veneti-Fagetum sylvaticae* of the calcareous heights, and *Staphyleo pinnatae-Fagetum sylvaticae*, of the flysch-like substrata.

European hornbeam woods

The woods with a dominance of *Carpinus betulus* and of *Quercus cerris* were previously assigned to *Carpinion betuli* for the Central-Western Apennine territories, and only for the Northern-Eastern sectors of Italy to the alliance *Erythronio-Carpinion*. The dendrogram shown in Fig. 2, allows the individuation of two main clusters grouping the relevés of the Central Apennines (I) and these of the Northern Apennines and the Karst near Trieste, respectively (II).

The first group includes the associations *Centaureo montanae-Carpinetum betuli* (Ia), *Carici sylvaticae-Quercetum cerridis* (Ib) and *Erythronio-Quercetum cerridis* (Ic). The second cluster includes the surveys of the associations *Physospermo-Quercetum petraeae* (IIa) and *Asaro-Carpinetum* (IIb).

Within the subclusters there have been individuated the following associations and subassociations:

CENTAUREO MONTANAECARPINETUM BETULI
Ubaldi & Speranza ex Ubaldi 1995
CENTAUREETOSUM MONTANAEC subass. nova
(type rel. n. 61 of Tab. 7 in Ubaldi & Speranza, 1985)
(rel. 1-13 of Tab. 3)
Variant with *Pyrus pyraster*
(rel. 14-21 of Tab. 3)
ARISARETOSUM PROBOSCIDEI subass. nova
(=Arisaro proboscidei-Carpinetum betuli Ubaldi & Speranza ex Ubaldi 1995)
(type rel. n. 4 of Tab. 6 in Ubaldi & Speranza, 1982)
(rel. 22-26 of Tab. 3)

The mixed woods with a dominance of *Quercus cerris* and *Carpinus betulus* found throughout the montane and submontane bioclimatic belts at heights between around

Lilium martagon L.	1.1	1.1	1.1	10
Arum maculatum L.	+2	+2	+2	+
Euphorbia amygdaloides L.	+2	1.2	1.2	1.1
Craathea laevigata (Poirer) DC	.	.	.	.
Rosa arvensis Hudson	.	.	.	8
Allium ursinum L.	.	.	.	8
Polygonatum multiflorum (L.) All.	.	.	.	7
Lonicera xylosteum L.	.	.	.	6
Lathyrus vernus (L.) Bernh.	.	.	.	6
Anemone ranunculoides L.	.	.	.	+2
Actaea spicata L.	.	.	.	5
Neottia nidus-avis (L.) L. C. Rich.	.	.	.	5
Asarum europaeum L.	.	.	.	5
Prunus avium L.	.	.	.	2
Ulmus glabra Hudson	.	.	.	2
Charact. species of <i>Querco-Fagetea</i>				
Viola reichenbachiana Jordan ex Boreau				19
Hedera helix L.	1.2	+2	2.3	+2
Acer campestre L.	+2	.	1.2	2.2
Primula vulgaris Hudson	.	+2	1.2	3.4
Hepatica nobilis Miller	.	1.1	1.1	2.2
Tamus communis L.	.	+2	+2	+2
Mycelis muralis (L.) Dumort.	1.1	+2	1.2	1.1
Campanula trachelium L.	.	+2	1.2	1.1
Corylus avellana L.	.	+2	1.2	2.2
Ostrya carpinifolia Scop.	.	+2	1.2	+2
Quercus cerris L.	1.2	.	1.2	1.1
Solidago virgaurea L.	.	.	+2	+
Cornus mas L.	.	.	1.1	+
Cephalanthera damasonium (Miller) Druce	.	.	1.2	+
Fraxinus ornus L.	.	1.1	1.1	2.2
Sympetrum bulbosum Schimper	.	.	.	+
Cruciata glabra (L.) Ehrend.	.	.	+2	+
Ilex aquifolium L.	.	.	.	+
Hieracium sylvaticum (L.) L.	.	.	.	+
Viburnum lantana L.	.	.	.	+
Epipactis muelleri Godfery	.	+2	+2	+
Ranunculus ficaria L.	.	+2	1.2	+
Lilium bulbiferum L. ssp. croceum (Chaix) Baker	.	1.2	1.1	+
Luzula sylvatica (Hudson) Gaudin	.	1.2	1.1	+
Stellaria nemorum L.	.	1.2	1.1	+
Other species				
Aegopodium podagraria L.	.	.	2.3	2.2
Geranium robertianum L.	.	+2	1.2	2.2
Rubus hispida W. et K.	+2	1.2	1.2	+
Geum urbanum L.	.	+2	1.2	1.1
Fragaria vesca L.	+2	+2	1.2	+
Cornus sanguinea L.	.	+2	1.2	+
Clematis vitalba L.	.	1.1	2.3	+
Peridium aquilellum (L.) Kuhn	.	+2	1.2	+
Crataegus monogyna Jacq.	.	+2	1.2	+
Luzula forsteri (Sm.) DC.	.	+2	1.2	+
Coronilla emerus L.	.	+2	1.2	+
Euonymus europaeus L.	.	+2	1.2	+
Heracleum sphondylium L. ssp. ternatum (Velen.) Brummitt	.	+2	1.2	+
Veratrum nigrum L.	.	+2	1.2	+
Accidental species				
5	2	4	7	3
2	5	3	5	2
1	1	3	7	-
2	1	2	1	-
3	2	3	1	-
1	1	3	2	-

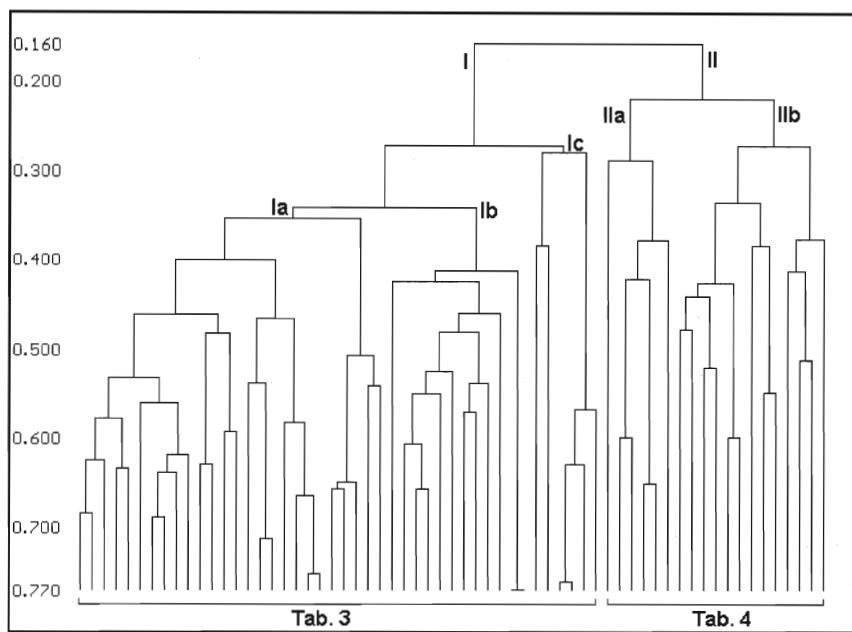


Fig. 2 - Dendrogram of the surveys of the European hornbeam woods of the Northern and Central Apennines and of the Karst near Trieste. The two main clusters group respectively the surveys of the Central Apennines, assigned to the *Pulmonario apenninae-Carpinenion betuli* suballiance (I), and those of the Northern Apennines and of the Karst near Trieste assigned to the *Asparago tenuifolii-Carpinenion betuli* suballiance (II). The first cluster includes the associations: *Centaureo montanae-Carpinetum betuli* (Ia), *Carici sylvaticae-Quercetum cerridis* (Ib) and *Erythronio-Quercetum cerridis* (Ic). The second cluster includes the associations: *Physospermo-Quercetum petraeae* (IIa) and *Asaro-Carpinetum* (IIb)

900 and 1100m on clay substratum and on subplain morphologies have been attributed to the association. The association has been described for the territories of Sasso Simone and Simoncello of upper Montefeltro (Ubaldi & Speranza, 1985). The characteristic and differential species are considered to be the following: *Centaurea montana*, *Carpinus betulus*, *Quercus cerris*, *Anemone trifolia* ssp. *trifolia*, *Geranium nodosum*, *Asarum europaeum*, *Rubus caesius*, *Tamus communis*, *Bromus ramosus*, *Iris graminea*, *Aegopodium podagraria*, *Astragalus glycyphyllos* and *Polygonatum multiflorum*.

The *centaureetosum montanae* subassociation subass. nova, corresponding to the association *typicum*, shows an impoverished variant (variant with *Pyrus pyraster*) where some of the more mesophilous species are either absent or present with low coverage.

The *arisaretosum proboscidei* subassociation subass. nova, represents a mesohygrophilous variant differentiated by *Arisarum proboscideum*, *Salvia glutinosa*, *Arum maculatum* and *Ostrya carpinifolia*, that can be found in cool locations often in the proximity of small streams, where it occupies the plain areas with a high water table and subjected to periodic flooding. This corresponds to the *Arisaro-Carpinetum* Ubaldi & Speranza ex Ubaldi 1995 association.

ERYTHRONIO DENTIS-CANIS-QUERCETUM

CERRIDIS ass. nova

(type rel. n. 29 of Tab. 3)

(rel. 27-32 of Tab. 3)

The woods with a prevalence of *Quercus cerris* and *Q. petraea* found on the clay formations of the chaotic complex of upper Val Marecchia, are assigned to the new association. These are deciduous mesophilous woods, mainly relict, that can be found at heights between 540 and 600m and that represent the climatophilous vegetation of the upper hilly belt. The characteristic and differential species are: *Lathyrus niger*, *Potentilla micrantha*, *Quercus petraea*, *Serratula tinctoria*, *Erythronium dens-canis* and *Malus florentina*.

CARICI SYLVATICAЕ-QUERCETUM CERRIDIS

Catorci & Orsomando 2001

(type rel. n. 18 of Tab. 10 in Catorci & Orsomando, 2001)

(rel. 33-44 of Tab. 3)

The association has been described for mixed mesophilous and acidofilous woods of the submontane belt (900-1000m a. s. l.) with a dominance of *Quercus cerris*, that can be found mainly on palaeosoils of the type of alfisols of the heights around the karst high plains

of Colfiorito and Montelago. The characteristic and differential species are considered to be the following: *Carex sylvatica*, *Platanthera chlorantha*, *Pulmonaria apennina*, *Cardamine kitaibelii*, *Silene viridiflora* and *Aristolochia pallida*.

PHYSOSPERMO-QUERCETUM PETRAEAE Oberd. & Hofm. 1967
(type rel. n. 3 of Tab.1 from Oberd. & Hofm., 1967 in Ubaldi, 1995)
(rel. 1-6 of Tab. 4)

The woods with a dominance of *Quercus petraea* that can be found on the hilly bioclimatic belt of a Northern Apennine sector that are part of the *Carpinion betuli* alliance are assigned to this association (Oberdorfer & Hofmann, 1967). Later, Ubaldi (1987 and 1995) assigned the *Physospermo-Quercetum petraeae* association to the *Erythronio-Quercion petraeae* alliance.

ASARO-CARPINETUM BETULI Lausi 1964
(summary Tab. in Lausi, 1964)
(rel. 7-19 of Tab. 4)

The association has been described for the woods with a dominance of *Carpinus betulus* that can be found on the Northern aspects of the dolina of the Karst near Trieste (Lausi, 1964). The characteristic species are considered to be the following: *Anemone nemorosa*, *Carpinus betulus*, *Asarum europaeum* and *Thamnium alopecurum*, to which the following differential species can be added: *Isopyrum thalictroides*, *Scilla bifolia*, *Mercurialis ovata*, *Ranunculus ficaria* ssp. *bulbifer*, *Gagea lutea*, *Maianthemum bifolium* and *Actaea spicata*.

European ash woods

The woods with a dominance of European ash, present within both the flysch formations of the Tuscany-Marche-Romagna Apennines and the calcareous formations of the Umbria-Marche Apennines, are assigned to the *Fraxino-Aceretum obtusati* association.

FRAXINO-ACERETUM OBTUSATI Ubaldi & Speranza ex Ubaldi 1995
(type rel. n. 74 of Tab. 6 in Ubaldi & Speranza, 1985)

QUERCETOSUM CERRIDIS subass. nova
(type rel. n. 74 of Tab. 6 in Ubaldi & Speranza, 1985)
(rel. 7-12 of Tab. 5)

POLYSTICHETOSUM SETIFERI subass. nova

(type rel. n. 4 of Tab. 5)
(rel. 1-6 of Tab. 5)

The association includes the mesohygrophilous woods with a dominance of *Fraxinus excelsior* to which *Acer obtusatum*, *A. pseudoplatanus* and *Corylus avellana* are associated, that can be found at the fall lines on humid and deep soils, at heights between around 800 and 1200m. The characteristic and differential species of the association present in the territory under consideration are: *Fraxinus excelsior*, *Acer obtusatum*, *Corylus avellana* and *Ribes multiflorum*. On the Tuscany-Marche-Romagna Apennine clay substrata, of the ash woods that are connected with the mesophilous woods of the *Centaureo montanae-Carpinetum betuli* association, it is possible to differentiate the new *quercetosum cerridis* subassociation (subassociation *typicum*). The differential species are considered to be the following: *Quercus cerris*, *Geranium nodosum*, *Pyrus pyraster*, *Helleborus bockonei* and *Asarum europaeum*.

On the calcareous heights of the Umbria-Marche Apennines the coenosis is present with the new *polystichetosum setiferi* subassociation which is well represented in the montane bioclimatic belt in chain connection with the beech woods of the *Cardaminio-Fagetum sylvaticae* association. The differential species of the new subassociation are: *Polystichum setiferum*, *Lathyrus venetus*, *Luzula sylvatica*, *Sorbus aria* and *Saxifraga rotundifolia*.

The authors assign the association to the *Euonymo-Fagenion sylvaticae* suballiance of the *Laburno-Ostryon carpinifoliae* alliance of the *Lathyro-Carpinetalia* order (Ubaldi & Speranza, 1985; Ubaldi et al., 1987).

DISCUSSION

In the nomenclature revision of the *Erythronio-Carpinion* alliance of Marinček (1994), there are described three suballiances for Southern-Eastern Europe, the ecology and distribution of which were later described in further detail by Marinček & Carni (2000). Among these suballiances, *Asparago tenuifolii-Carpinenion betuli* is the closest to the Italian woods as it includes European hornbeam formations that are considered to be extrazonal Illyrics and of the subMediterranean area, while the others are strictly linked to the Illyric floristic province and, in particular, the suballiance *Erythronio-Carpinenion betuli* includes the European hornbeam woods of the prealpine and predinaric phytogeographic region and the *Lonicero caprifoliae-Carpinenion betuli* suballiance groups together those of the subpannonic phytogeographic region.

<i>Lonicera caprifolium</i> L.	
<i>Cratagis laevigata</i> (Poirer) DC.	
<i>Crucia glabra</i> (L.) Ehrend.	
<i>Coris mas</i> L.	
<i>Fraxinus ornus</i> L.	
<i>Artemisia agannoides</i> (L.) DC.	
<i>Stellaria holostea</i> L.	
	Charact. and diff. species of <i>Fraxinia sylvatica</i>
<i>Rosa arvensis</i> Hudson	
<i>Festuca heterophylla</i> Lam.	
<i>Acer campestre</i> L.	
<i>Melica uniflora</i> Rez.	
<i>Lathys venaeus</i> (Miller) Wohlf.	
<i>Fagus sylvatica</i> L.	
<i>Sanecula europaea</i> L.	
<i>Cardamine bulbifera</i> (L.) Crantz	
<i>Euphorbia amygdaloides</i> L.	
<i>Lilium martagon</i> L.	
<i>Euphorbia dulcis</i> L.	
<i>Prunus avium</i> L.	
<i>Gallium odoratum</i> (L.) Scop.	
<i>Scilla bifolia</i> L.	
<i>Hieracium sylvaticum</i> (L.) L.	
<i>Neotia nidus-avis</i> (L.) L. C. Rich.	
<i>Ace paeophytana</i> L.	
<i>Sympium bulbosum</i> Schimpfer	
<i>Polystichum setiferum</i> (Forskal) Woynar	
<i>Adonis moschata</i> L.	
<i>Lathys vernus</i> (L.) Berth.	
<i>Anemone ranunculoides</i> L.	
<i>Omphigodium pyrenaicum</i> L.	
<i>Vinca minor</i> L.	
	Charact. and diff. species of <i>Quercus-Fagetea</i>
<i>Quercus cerris</i> L.	
<i>Hepatica nobilis</i> Miller	
<i>Hedera helix</i> L.	
<i>Viola reichenbachiana</i> Jordan ex Boreau	
<i>Sorbus terminalis</i> (L.) Crantz	
<i>Corylus avellana</i> L.	
<i>Solidago virgaurea</i> L.	
<i>Stachys officinalis</i> (L.) Trevisan	
<i>Melittis melissophyllum</i> L.	
<i>Brachypodium sylvaticum</i> (Hudson) Beauv.	
<i>Auga repens</i> L.	
<i>Viburnum lantana</i> L.	
<i>Malus sylvestris</i> Miller	
<i>Anemone nemorosa</i> L.	
<i>Ilex aquifolium</i> L.	
<i>Cephalanthus damascenon</i> (Miller) Drue	
<i>Rhus acetosa</i> L.	
<i>Sorbus domestica</i> L.	
<i>Laburnum anagyroides</i> Medicus	
<i>Carex digitata</i> L.	
<i>Bulgosiaes purpureocaulis</i> (L.) Johnson	
<i>Cephaelanthus longifolius</i> (Hudson) Fries	
<i>Ulmus minor</i> Miller	
<i>Epipactis muelleri</i> Godfery	
<i>Mercurialis perennis</i> L.	
<i>Rhus hypoglossum</i> L.	
	Other species
<i>Cratagis monogyna</i> Jacq.	
<i>Ligustrum vulgare</i> L.	
<i>Fragaria vesca</i> L.	
<i>Euonymus europaeus</i> L.	
<i>Luzula forsteri</i> (Sm.) DC.	
<i>Prunus spinosa</i> L.	
<i>Corus sanguineus</i> L.	
<i>Carex flacca</i> Schreb.	
<i>Coronilla emerus</i> L.	
<i>Juniperus communis</i> L.	
	Accidental species
4	- 1 3 1 4 1 - 2 3 1 2 - 4 3 3 - 4 2 2 8 6 2 5 4 7 2 6 3 - 2 7 1 3 4 1 1 3 4 6 4 4

Sambucus nigra L.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	+	1	.	1	5	
Melittis melissophyllum L.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	4	.	4	
Brachypodium sylvaticum (Hudson) Beauv.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	1	+	.	.	.	.	.	4	.	4	
Castanea sativa Miller	2	.	+	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	4
Serratula tinctoria L.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	4	.	4
Lathyrus niger (L.) Bernh.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	3
Potentilla micrantha Ramond	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	3
Other species																										
Crataegus monogyna Jacq.	1	+	+	+	+	+	+	+	.	1	.	.	.	.	.	.	+	1	2	.	.	1	12	.	12
Euonymus europaeus L.	.	.	.	.	.	.	.	+	1	1	.	1	1	.	.	.	+	.	.	.	+	.	7	.	7
Aegopodium podagraria L.	.	.	.	.	.	.	.	+	+	1	+	.	.	.	.	+	1	.	.	.	.	.	6	.	6
Robinia pseudoacacia L.	.	.	.	.	.	.	.	1	.	1	1	2	2	.	.	1	.	.	.	.	.	.	6	.	6
Cornus sanguinea L.	2	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	5	.	5
Melica nutans L.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	1	1	+	.	.	.	.	.	5	.	5
Conopodium majus (Gouan) Loret	.	+	.	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	4
Glechoma hederacea L.	.	.	.	.	.	.	.	1	.	+	1	+	.	.	.	.	.	.	.	.	.	.	4	.	4
Dactylis glomerata L.	.	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	3
Asplenium trichomanes L.	+	.	.	+	1	1	3	.	3
Geranium robertianum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	2	2	3	.	3	
Accidental species																										
	14	9	12	3	3	6	2	4	1	-	-	-	1	3	2	1	2	1	-	-	-	-	-	-	-	

Considering the table constructed arranging the surveys of the European hornbeam woods on the basis of the dendrogram, it is possible to assign to the *Erythronio-Carpinion* alliance also the *Physospermo-Quercetum petraeae* association previously assigned to the Central Europe *Carpinion betuli* alliance. In particular, the association should be assigned to the *Asparago tenuifolii-Carpinenion betuli* suballiance. Therefore, the *Erythronio-Carpinion* alliance would include all the mesophilous woods of the Northern Apennines and of the Southern Alps, while the *Carpinion* would reach, without going beyond, the Northern aspect of the Alpine chain and would be substituted in the South by *Erythronio-Carpinion*. In the Central and Northern-Central Apennines there is instead present a Southern variant of the alliance with the proposed name of *Pulmonario apenninae-Carpinenion betuli* suball. nova, whose type is the *Centaureo montanae-Carpinetum betuli* association. The characteristic and differential species of the new suballiance are: *Geranium nodosum*, *Pulmonaria apennina*, *Anemone trifolia* ssp. *trifolia*, *Helleborus boconeai* and *Cyclamen hederifolium*.

The European ash woods in Tab. 5 are also considered to be part of the Apennine *Pulmonario apenninae-Carpinenion betuli* suballiance within which they represent meso-hygrophilous woods in transition towards the much more hygrophilous woods of the *Tilio-Acerion* alliance. Also in the insubrian area of the Padanian Subprovince, Oberdorfer (1964) individuated ash woods that he proposes to include in *Carpinion betuli*, but that we consider instead to be a part of the *Erythronio-Carpinion betuli* alliance.

Sycamore and hop hornbeam woods

The ravine woods (Tab. 6-7) are differentiated according to physiognomic-structural aspects and

ecology. In the montane bioclimatic belt, woods with a dominance of sycamore that are assigned to the *Aceretum obtusati-pseudoplatani* association can be found, while in the hilly belt, woods with a dominance of hop hornbeam of the *Lunario redivivae-Ostryetum carpinifoliae* association can be found.

ACERETUM OBTUSATI-PSEUDOPLATANI ass. nova (type rel. n. 1 of Tab. 6)

The sycamore woods with *Phyllitis scolopendrium* that are widely spread throughout the calcareous massifs of Europe, have been mainly assigned to the *Phyllitido-Aceretum pseudoplatani* Moor 1952 association. The coenosis grows in the areas characterised by persistent edaphic and atmospheric humidity, protected from the wind, with the presence of big calcareous rocks or at the base of steep aspects where detritus layers gather. The association generally spread throughout the lower montane bioclimatic belt, can reach down into the hilly belt if the humidity conditions are maintained. The composition of the arboreal layer is represented by *Acer pseudoplatanus*, *Fraxinus excelsior* and *Tilia platyphyllos*, with which there is also *Ulmus glabra*, while in the herbaceous layer there are calcicole and talus-slope species (Clot, 1990).

The woods found in the Central Apennines occupy the same ecological position as the association presented here, with respect to which it has a notable structural affinity, while the difference in its plant composition is influenced by the southern location of the stations. Previously, for the Umbria-Marche Apennines, the *Ornithogalo sphaerocarpi-Aceretum pseudoplatani* Taffetani 2000 association was recognised, which is found still in a ravine situation, but on siliceous substrata. The surveys of Tab. 6 show a notable plant diversity with respect to those of the association indicated for which the new *Aceretum obtusati-pseudoplatani* association is described; characteristic species of this association are considered

Tab. 5 - *FRAXINO EXCELSIORIS-ACERETUM OBTUSATI* Ubaldi & Speranza ex Ubaldi 1995

subass. *polystichetosum setiferi* subass. nova (rel. 1-6)
 subass. *quercketosum cerris* subass. nova (rel. 7-12)

Rel. n.	1	2	3	4*	5	6	7	8	9	10	11	12	P
Altitude (m)	1175	1120	950	950	900	850	1010	1120	1120	1105	1150	1140	r
Exposure	NNE	N	NE	NNE	NNW	ENE	SW	SE	E	N-NE	NE	E-NE	e
Slope (°)	50	55	35	45	45	45	25	20	30	3	15	15	s.
Coverage (%)	85	85	100	90	100	95	90	95	100	90	90	90	
Area (m ²)	150	100	200	150	600	100	200	200	200	100	150	80	
Charact. species of ass.													
<i>Fraxinus excelsior</i> L.	4.4	4.4	4.5	4.4	4.5	3.3	3.3	3.3	3.3	4.5	5.5	4.5	12
<i>Acer obtusatum</i> W. et K.	3.3	2.2	3.4	2.3	1.2	3.3	1.1	1.2	.	.	.	.	8
<i>Corylus avellana</i> L.	.	.	.	2.3	.	1.1	3.3	4.5	3.3	.	1.2	2.2	7
<i>Ribes multiflorum</i> Kit.	.	.	.	.	.	.	.	.	+2	.	.	.	1
Diff. species of <i>polystichetosum setiferi</i>													
<i>Polystichum setiferum</i> (Forsskål) Woynar	+	+	+2	2.2	2.2	2.2	.	.	.	.	.	.	6
<i>Lathyrus venetus</i> (Miller) Wohlf.	+	+	1.1	+	+	1.1	.	.	.	.	.	.	6
<i>Luzula sylvatica</i> (Hudson) Gaudin	1.1	+	1.2	1.2	1.2	.	.	.	.	.	.	.	5
<i>Sorbus aria</i> (L.) Crantz	1.1	1.1	1.1	.	.	2.3	1.1	.	.	.	.	.	5
<i>Saxifraga rotundifolia</i> L.	.	.	+2	1.1	2.2	.	+	.	.	.	.	.	4
Diff. species of <i>quercketosum cerris</i>													
<i>Quercus cerris</i> L.	.	.	.	.	.	.	+	3.3	2.3	+	1.2	1.2	6
<i>Helleborus borealis</i> Ten.	.	.	.	.	.	.	.	1.2	2.2	2.2	2.3	+	5
<i>Geranium nodosum</i> L.	.	.	.	.	.	.	1.2	.	.	2.3	1.2	2.3	4
<i>Pirus pyraster</i> Burgsd.	.	.	.	.	.	.	+	.	1.2	.	+	1.2	4
<i>Asarum europaeum</i> L.	.	.	.	.	.	.	.	.	.	1.1	2.2	1.2	3
Diff. species of the suball. <i>Pulmonario apenninae-Carpinetion betuli</i>													
<i>Daphne laureola</i> L.	.	.	.	.	1.1	+	.	+	+	1.1	+	+	8
<i>Lonicera xylosteum</i> L.	.	.	+2	+	.	+2	1.1	+	1.2	.	+	.	7
<i>Viola alba</i> Besser ssp. <i>dehnhardtii</i> (Ten.) W. Becker	2.2	1.1	1.1	+	.	.	.	2.2	1.2	.	.	.	6
<i>Lilium bulbiferum</i> L. ssp. <i>croceum</i> (Chaix) Baker	.	.	+	.	.	.	+	+	.	.	+	.	4
<i>Euonymus latifolius</i> (L.) Miller	+	.	.	.	+	.	+	.	.	.	.	.	3
<i>Centaurea montana</i> L.	.	.	.	.	.	2.2	.	.	.	.	.	+	2
<i>Cyclamen hederifolium</i> Aiton	.	.	.	2.2	.	.	.	.	.	.	.	.	1
<i>Pulmonaria apennina</i> Cristof. & Puppi	.	.	.	.	.	.	.	.	.	.	1.2	.	1
<i>Anemone trifolia</i> L. ssp. <i>trifolia</i>	.	.	.	.	.	.	.	.	.	.	+	.	1
<i>Dactylorhiza fuchsii</i> (Druce) Soó	.	.	+	.	.	.	.	.	.	.	.	.	1
<i>Ornithogalum sphaerocarpum</i> Kerner	.	.	.	.	1.1	.	.	.	.	.	.	.	1
<i>Lamiastrum galeobdolon</i> (L.) Ehrend. et Polatschek	.	.	.	.	.	1.1	.	.	.	.	.	.	1
ssp. <i>flavidum</i> (F.Hermann) Ehrend. et Pola.	.	.	.	.	.	.	1.1	.	.	.	.	.	1
Charact. and diff. species of <i>Erythronio dentis-canis-Carpinion betuli</i>													
<i>Acer campestre</i> L.	1.1	+	+	2.3	1.2	1.2	.	4.4	2.3	2.3	3.4	2.2	11
<i>Crataegus laevigata</i> (Poirier) DC	.	1.1	.	2.2	2.2	1.2	.	1.2	1.2	+	1.1	1.2	9
<i>Polygonatum multiflorum</i> (L.) All.	1.1	1.1	+2	.	2.2	.	.	.	.	.	+	+	6
<i>Primula vulgaris</i> Hudson	.	.	.	.	+	.	+2	.	2.2	.	1.1	1.1	5
<i>Carpinus betulus</i> L.	.	.	.	1.1	.	2.3	.	.	.	2.3	2.2	1.2	5
<i>Stellaria holostea</i> L.	+	+	+	.	1.2	.	.	.	.	.	.	.	4
<i>Cornus mas</i> L.	.	.	.	2.2	.	2.2	.	+	.	.	.	.	3
<i>Rosa arvensis</i> Hudson	.	.	.	.	2.2	.	.	.	1.2	.	+	.	3
<i>Fraxinus ornus</i> L.	.	.	.	3.3	2.3	.	.	.	.	.	.	.	2
<i>Artemisia agrimonoides</i> (L.) DC.	.	.	.	.	.	.	.	+	.	+	.	.	2
Charact. species of <i>Fagetalia sylvaticae</i>													
<i>Fagus sylvatica</i> L.	2.2	+	+	1.1	+	1.2	1.1	.	3.3	1.2	1.2	2.2	11
<i>Melica uniflora</i> Retz.	1.1	1.1	3.3	1.1	.	1.2	1.2	1.2	+	.	1.2	1.2	10
<i>Acer pseudoplatanus</i> L.	1.1	2.2	.	.	.	1.1	1.1	1.2	.	1.2	2.2	2.2	8
<i>Festuca heterophylla</i> Lam.	1.1	2.2	+2	.	1.2	2.2	+	.	+	.	+	.	8
<i>Euphorbia dulcis</i> L.	+	+	+2	.	1.2	.	.	.	1.2	+	+	+	8
<i>Mercurialis perennis</i> L.	+	+2	1.2	1.1	3.3	.	.	.	.	.	.	.	5
<i>Euphorbia amygdaloides</i> L.	+2	+	.	.	.	.	.	.	+	.	1.1	.	4
<i>Epilobium montanum</i> L.	+	+	.	.	.	.	+	.	.	.	.	.	3
<i>Asperula taurina</i> L.	.	.	.	.	2.2	.	.	.	.	+2	.	1.2	3
<i>Galium odoratum</i> (L.) Scop.	.	.	.	.	+	1.1	1.1	.	.	.	.	.	3
<i>Dryopteris filix-mas</i> (L.) Schott	1.1	+	+	.	.	.	.	.	.	.	.	.	3
<i>Doronicum columnae</i> Ten.	.	.	+	.	.	.	2.2	.	.	.	.	.	2
<i>Paris quadrifolia</i> L.	.	.	.	.	.	.	.	.	+	.	+	.	2
<i>Sanicula europaea</i> L.	.	.	.	.	.	.	.	.	.	+2	+	.	2
<i>Lilium martagon</i> L.	.	.	+	.	.	.	.	.	.	+	.	.	2
<i>Agropyron caninum</i> (L.) Beauv.	2.2	2.2	.	.	.	.	.	.	.	.	.	.	2
<i>Campanula latifolia</i> L.	+	.	1.1	.	.	.	.	.	.	.	.	.	2
<i>Ranunculus lanuginosus</i> L.	.	.	.	.	.	.	.	+	+	.	.	.	2

Charact. species of the class *Querco-Fagetea*

<i>Hepatica nobilis</i> Miller	.	+	.2	+	.	.	+	.	+	+	1.1	.	7
<i>Hedera helix</i> L.	.	.	.	1.1	1.2	2.3	.	.	1.2	+	.	.	5
<i>Ostrya carpinifolia</i> Scop.	.	.	+	.2	+	.	1.1	.	.	.	.	.	4
<i>Viola reichenbachiana</i> Jordan ex Boreau	1.1	1.1	.	.	.	.	.	.	.2	+	.	.	4
<i>Brachypodium sylvaticum</i> (Hudson) Beauv.	3.3	2.2	.	.	1.2	.	.	.	.	.	.	.	3
<i>Melittis melissophyllum</i> L.	.	+	1.2	.	.	.	+	.	.	.	.	.	3
<i>Mycelis muralis</i> (L.) Dumort.	+	+	+	.	.	.	.	.	.	.	.	.	3
<i>Campanula trachelium</i> L.	+	+	.	.	.	.	.	.	.	.	.	.	2
<i>Cephalanthera longifolia</i> (Hudson) Fritsch	.	.	+	.	.	.	.	.	.	.	.	+	2
<i>Ajuga reptans</i> L.	.	.	.	.	.	.	.	.	+	.	+	.	2
<i>Solidago virgaurea</i> L.	.	.	1.2	1.1	.	.	.	.	.	.	.	.	2
<i>Viburnum lantana</i> L.	.	.	.	.	+	.	.	.	.	.	.	+	2
<i>Tamus communis</i> L.	.	.	+	.	+	.	.	.	.	.	.	.	2
Other species													
<i>Geranium robertianum</i> L.	2.2	1.1	.	+	+	+	1.2	1.2	+	+	.	.2	10
<i>Geum urbanum</i> L.	+	+	+	.	.	.	.	+	+	.	+	+	7
<i>Clematis vitalba</i> L.	.	.	+	.	.	.	1.1	+	1.2	.2	.	+	6
<i>Rubus caesius</i> L.	.	.	.	.	.	.	.	1.1	1.2	+	1.2	1.2	5
<i>Dactylis glomerata</i> L.	+	+	+	.2	.	.2	.	.	.	.	.	.	5
<i>Arabis turrita</i> L.	+	1.1	+	.	+	.	.	.	.	.	.	.	4
<i>Crataegus monogyna</i> Jacq.	.	.	.	.	.	1.2	.	+	1.2	.	.	.	3
<i>Rosa canina</i> L.	.	.	.	1.1	.	.	+	.	+	.	.	.	3
<i>Coronilla emerus</i> L.	.	.	+	.	.	1.1	+	.	.	.	.	.	3
<i>Fragaria vesca</i> L.	+	+	.	+	.	.	.	.	.	.	.	.	3
<i>Ligustrum vulgare</i> L.	.	.	.	.	+	.	.	.	+	.	.2	.	3
<i>Aegopodium podagraria</i> L.	.	.	.	.	.	.	.	.	.	2.3	1.2	1.2	3
<i>Hypericum hirsutum</i> L.	+	+	+	.	.	.	.	.	.	.	.	.	3
<i>Stachys sylvatica</i> L.	1.1	+	.	+	.	.	.	.	.	.	.	.	3
<i>Rubus ulmifolius</i> Schott	1.1	.	.	1.2	.	3.3	.	.	.	.	.	.	3
Accidental species	4	8	18	1	-	5	6	7	3	4	3	2	

to be some species with an Eastern distribution, such as: *Acer obtusatum*, *Asperula taurina*, *Glechoma hirsuta*, *Corydalis cava*, *Cardamine enneaphyllos* and *Galanthus nivalis*. The complex of the Southern and Mediterranean species, such as: *Ruscus aculeatus*, *Arum italicum* and *Pulmonaria apennina*, differentiates it from similar Central and Northern-Eastern formations.

LUNARIO REDIVIVAE-OSTRYETUM CARPINIFOLIAE ass. nova

(type rel. n. 1 of Tab. 7)

The rocky woods with a dominance of hop hornbeam with flowering ash that are localised in ravine positions are referred to this new association. These woods are characterised by the presence of some species of the *Tilio-Acerion* alliance, such as *Lunaria rediviva*, *Staphylea pinnata*, *Euonymus latifolius*, *Tilia platyphyllos* and *Ulmus glabra*. The localisation of the woods at modest heights within the hilly bioclimatic belt and the presence of Southern and Eastern aspects, determine temperate microclimatic conditions that do not guarantee the persistence of sufficient humidity levels for the presence of mesophilous species of the *Fagetalia* order and therefore of the *Tilio-Acerion* alliance. It is thought therefore that the new association can be assigned to the *Laburno-Ostryenion carpinifoliae* suballiance. The following species are considered to be characteristic and differential of the new association: *Ostrya carpinifolia*, *Lunaria rediviva*, *Fraxinus ornus*,

Euonymus latifolius, *Phyllitis scolopendrium*, *Ulmus glabra*, *Ruscus aculeatus*, *Quercus ilex* and *Staphylea pinnata*.

DISCUSSION

The associations described here present a clear azonal distribution because they localise exclusively in ravine or gully conditions. In relation to the microclimatic conditions that can be found in these geomorphological situations, the presence of woods that can therefore be assigned to two ecological contexts can be seen. In the cooler and more humid situations, the *Aceretum obtusati-pseudoplatani* association can be found, which is part of the *Tilio-Acerion* alliance, within which it presents some thermophilous and Southern differential species. On the other hand, in the warmer and dryer situations, the vegetation is deprived of Northern elements for which the *Lunario redivivae-Ostryetum carpinifoliae* association is fully localised within the woods of the *Ostryo-Carpinion orientalis* alliance, which includes the woods of the hilly belt of the calcareous Apennines.

Conclusions

The present study allows the reinterpretation of the Apennine forest vegetation in biogeographical terms,

Tab. 6 - ACERETUM OBTUSATI-PSEUDOPLATANI ass. nova

Rel. n.	1*	2	P
Altitude (m)	600	650	r
Exposure	W	NNNE	e
Slope (°)	35	30	s.
Coverage (%)	100	100	
Area (m ²)	80	50	

Charact. and diff. species

Corydalis cava (L.) Schweigg. et Koerte	2.2	1.1	2
Galanthus nivalis L.	2.3	1.2	2
Asperula taurina L.	1.1	1.1	2
Glechoma hirsuta W. et K.	+	+	2
Acer obtusatum W. et K.	1.2	2.2	2
Ruscus aculeatus L.	2.2	1.2	2
Arum italicum Miller	1.2	+	2
Cardamine enneaphyllos (L.) Crantz	+	1.1	2
Pulmonaria apennina Cristof. & Puppi	+	.	1

Charact. and diff. species of *Tilio-Acerion*

Ulmus glabra Hudson	3.3	3.3	2
Acer pseudoplatanus L.	3.3	1.2	2
Phyllitis scolopendrium (L.) Newman	3.3	3.3	2
Saxifraga rotundifolia L.	2.2	2.2	2
Geranium robertianum L.	1.2	+	2
Fraxinus excelsior L.	+	.	1
Acer platanoides L.	1.1	+	1
Tilia platyphyllos Scop.	+	.	1

Charact. species of *Fageta sylvaticae*

Polystichum setiferum (Forsskal) Woynar	2.2	2.2	2
Melica uniflora Retz.	+	+	2
Galium odoratum (L.) Scop.	2.2	2.2	2
Fagus sylvatica L.	2.2	1.1	2
Euphorbia amygdaloides L.	+	+	2
Adoxa moschatellina L.	+	+	2
Cardamine bulbifera (L.) Crantz	1.1	1.1	2
Mercurialis perennis L.	+	2.2	2
Crataegus laevigata (Poirier) DC.	+	+	2
Sanicula europaea L.	1.1	.	1
Euonymus latifolius (L.) Miller	+	.	1
Gagea lutea (L.) Ker-Gawl.	+	.	1
Salvia glutinosa L.	1.1	.	1
Euphorbia dulcis L.	+	.	1
Festuca heterophylla Lam.	1.1	.	1
Scilla bifolia L.	+	.	1
Stellaria holostea L.	+	.	1
Ranunculus lanuginosus L.	+	.	1
Acer campestre L.	.	2.3	1
Carpinus betulus L.	.	1.2	1
Arum maculatum L.	.	1.1	1

Charact. species of *Querco-Fagetea*

Daphne laureola L.	1.2	+	2
Corylus avellana L.	+	3.3	2
Hedera helix L.	3.3	2.3	2
Ostrya carpinifolia Scop.	1.2	1.2	2
Brachypodium sylvaticum (Hudson) Beauv.	1.1	+	2
Primula vulgaris Hudson	+	1.2	2
Lonicera xylosteum L.	+	2	2
Ajuga reptans L.	+	+	2
Ilex aquifolium L.	2.2	+	2
Carex digitata L.	+	+	2
Sambucus nigra L.	1.1	+	2
Viola reichenbachiana Jordan ex Boreau	+	.	1
Campanula trachelium L.	+	.	1
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	+	.	1
Hepatica nobilis Miller	+	.	1
Melittis melissophyllum L.	+	.	1
Cruciata glabra (L.) Ehrend.	+	.	1
Mycelis muralis (L.) Dumort.	+	.	1
Dactylorhiza fuchsii (Druce) Soó	+	.	1
Lathyrus venetus (Miller) Wohlf.	+	.	1
Ruscus hypoglossum L.	.	+	1
Cornus mas L.	+	+	1

Other species

Fragaria vesca L.	+	+	2
Urtica dioica L.	+	+	2
Cardamine graeca L.	1.1	+	2

Accidental species

11 4

Tab. 7 - LUNARIO REDIVIVAE-OSTRYETUM CARPINIFOLIAE ass. nova

Rel. n.	1*	2	3	4	P
Altitude (m)	600	550	580	600	r
Exposure	-	-	-	ESE	e
Slope (°)	-	-	-	30	s.
Coverage (%)	90	100	100	85	
Area (m ²)	200	100	50	250	

Charact. and diff. species

Ostrya carpinifolia Scop.	4.5	4.5	3.3	4.4	4
Fraxinus ornus L.	2.2	2.3	1.2	3.4	4
Lunaria rediviva L.	4.4	3.3	2.3	2.2	4
Ruscus aculeatus L.	2.3	+	.	+	3
Euonymus latifolius (L.) Miller	3.3	.	1.1	.	2
Quercus ilex L.	1.2	.	.	+	2
Phyllitis scolopendrium (L.) Newman	+	.	.	.	1
Staphylea pinnata L.	+	.	.	.	1
Ulmus glabra Hudson	.	.	3.3	.	1

Charact. and diff. species of <i>Ostryo-Carpinion orientalis</i> and <i>Laburno-Ostryenion</i>	1.1	1.2	2.3	1.1	4
Acer obtusatum W. et K.	1.1	1.2	2.3	1.1	4
Daphne laureola L.	.	1.2	+	1.1	3
Helleborus foetidus L.	.	.	+	.	1
Lathyrus venetus (Miller) Wohlf.	.	.	+	.	1
Coronilla emerus L.	.	.	.	+2	1
Bromus ramosus Hudson	.	.	.	1.2	1
Digitalis micrantha Roth	.	.	.	+	1

Charact. species of *Fagetalia sylvaticae*

Acer campestre L.	1.2	1.2	1.1	1.1	4
Mercurialis perennis L.	+	2.3	1.2	.	3
Melica uniflora Retz.	.	1.2	1.2	3.3	3
Polystichum setiferum (Forsskal) Woynar	.	+2	+	+	3
Fagus sylvatica L.	.	1.2	1.2	+	3
Saxifraga rotundifolia L.	1.1	.	.	.	1
Euphorbia amygdaloidea L.	+	.	.	.	1
Galanthus nivalis L.	1.2	.	.	.	1
Corydalis cava (L.) Schweigg. et Koerte	1.2	.	.	.	1
Asperula taurina L.	.	+	.	.	1
Sanicula europaea L.	.	1.2	.	.	1
Allium ursinum L.	.	+	.	.	1
Cardamine enneaphyllos (L.) Crantz	.	.	1.2	.	1
Salvia glutinosa L.	.	.	.	2.3	1
Pulmonaria apennina Cristof. & Puppi	.	.	.	+2	1
Acer pseudoplatanus L.	.	.	.	1.1	1

Charact. species of *Quercetalia pubescens-petraeae* and *Querco-Fagetea*

Hedera helix L.	4.4	4.5	1.2	4.4	4
Mycelis muralis (L.) Dumort.	1.1	1.1	1.1	2.2	4
Viola reichenbachiana Jordan ex Boreau	.	2.2	1.2	2.2	3
Solidago virgaurea L.	+	.	.	+2	2
Tamus communis L.	+	.	+	.	2
Cornus mas L.	.	1.2	+2	.	2
Corylus avellana L.	.	2.2	.	2.2	2
Milium effusum L.	.	+	.	.	1
Primula vulgaris Hudson	.	+2	.	.	1
Viola alba Besser ssp. dehnhardtii (Ten.) W. Beck	.	.	+	.	1
Ilex aquifolium L.	.	.	.	+	1

Other species

Sambucus nigra L.	3.4	4.4	2.2	1.2	4
Geranium robertianum L.	1.2	+	+	.	3
Clematis vitalba L.	1.2	1.2	1.2	.	3
Parietaria officinalis L.	+2	+2	+	.	3
Euonymus europaeus L.	1.2	1.2	.	.	2

Accidental species

3 1 - 1

whereby it evidentiates the contribution of the Eastern species to the constitution of the Apennine forest associations. These appear linked, also at the level of alliance, to the Balkan units, as becomes evident from the biogeographical representation of the peninsular, Padanian and Apennine Italian territories that are indicated as subprovinces of the Appenine-Balkan province (Fig. 3) (Rivas-Martinez *et al.*, 2001). This

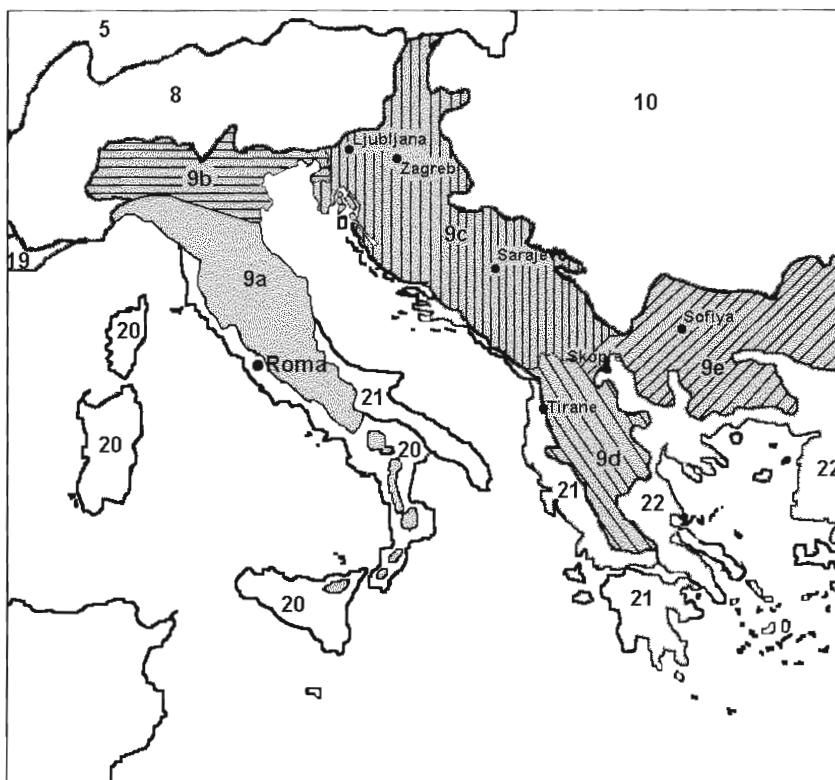


Fig. 3 - Biogeographical map: in evidence, the Apennine-Balkan Province with the Apennine (9a), Padanian (9b), Illyrian (9c), Pindan (9d) and Bulgarian (9e) Subprovinces (redesigned and modified from Rivas Martinez *et al.*, 2001)

link has been previously recognised for the vegetation of the mixed deciduous woods, of the hilly bioclimatic belt, that are included in the *Ostryo-Carpinion orientalis* alliance, and assigned to the *Lauro-Quercenion pubescens* suballiance, for the mainly thermophilous pre-Apennine coenosis rich in Mediterranean species, and to the *Laburno-Ostryenion carpinifoliae* suballiance for the more mesophilous Apennine and inland coenosis. The research undertaken also reveals the link with the Eastern system for the woods with prevalence of beech, and therefore with the *Aremonio-Fagion* alliance with the *Cardamino kitaibelii-Fagenion sylvaticae* suball. *nova loco*. With this study it has been also possible to show the presence of beech woods in the Central Apennines that are connected with the Southern *Geranio versicoloris-Fagion* alliance, determining a condition of a height-dependent substitution, which causes the presence at the lower levels of associations that can be assigned to the latter alliance, while exclusively at the highest sectors, impoverished forms of the Northern *Cardamino kitaibelii-Fagenion sylvaticae* suballiance are conserved. Furthermore, it is thought that the presence of beech woods on the heights of the Southern Apennines and in some areas of Sicily (Brullo *et al.*, 2001) allows the

assignment of the territories with a potentiality for these woods to the Eurosiberian region, since although Southern, the beech woods maintain mainly a Northern floral component and develop in conditions of temperate bioclimate (Biondi & Baldoni, 1993 and 1995). It is therefore thought that the Apennine Subregion extends to the Southern limits of the Italian peninsula, and that it also includes a limited North-Eastern sector of Sicily. The beech woods of these territories belong to the *Geranio versicoloris-Fagion* alliance with the *Doronico-Fagenion* suballiance in the thermophilous woods, and with the *Lamio-Fagenion* in the microthermal ones (Di Pietro, 2002). On the basis of this interpretation, a series of "biogeographical islands" can be seen in the context of the Mediterranean region, as shown in Fig. 3.

Also for the European hornbeam woods the link with the analogous Eastern formation is proposed. These woods are assigned to the *Erythronio dentis-canis-Carpinion betuli* alliance, occurring in Italy with the *Asparago tenuifolii-Carpinenion betuli* suballiance in the Padanian district and with the *Pulmonario apenninae-Carpinenion betuli* suballiance in the Apennine one. Analogous reasoning can be proposed for the formations of *Tilio-Acerion*.

Syntaxonomical scheme

As a conclusion to the study, the syntaxonomic scheme of the Apennine mesophilous woods of Central-Northern Apennines is presented, where the main associations that have been described are indicated, also if not directly presented in this work.

QUERCO-FAGETEA Br.-Bl. & Vlieger in Vlieger 1937

Fagetalia sylvaticae Pawłowski in Pawłowski, Sokolowski & Wallisch 1928

Aremonio-Fagion sylvaticae (Horvat 1938) Torok, Podani & Borhidi 1989

Cardamino kitaibelii-Fagetion sylvaticae suball. nova

Trochiscantho-Fagetum sylvaticae Gentile 1974

Gymnocarpio-Fagetum Ubaldi & Speranza 1985 ex Ubaldi 1995

(= *Abieti-Fagetum piceetosum* sensu Ubaldi, in Credano *et al.* 1980 n.n.; = *Abieti-Fagetum valerianetosum* Ubaldi 1980)

Cardamino kitaibelii-Fagetum sylvaticae Ubaldi *et al.* ex Ubaldi 1995

(= *Polysticho-Fagetum* Feoli & Lagonegro ex Biondi *et al.* 1999)

Dactylorrhiza fuchsii-Fagetum sylvaticae (Biondi *et al.* 1989) Biondi & Izco 1992

(= *Carici sylvaticae-Fagetum* Biondi *et al.* 1989)

Solidagini-Fagetum sylvaticae (Longhitano & Ronsisvalle 1974) Ubaldi *et al.* ex Ubaldi 1995

(= *Dactylorrhiza-Fagetum* Ubaldi *et al.* 1987 *nomen invalidum* non (Biondi *et al.* 1989) Izco & Biondi 1992; = *Veronica-Fagetum* Feoli & Lagonegro 1982 non Montacchini 1972; = *Aquifolio-Fagetum*

Longhitano & Ronsisvalle 1974; *Aquifolio-Fagetum* Ronsisvalle 1979, non Gentile 1969; = *Abieti-Fagetum*

Longhitano & Ronsisvalle 1974; Ronsisvalle 1979; = *Veronica-Fagetum* Pedrotti 1982 non Montacchini 1972)

Monotropo-Fagetum Arrigoni & Nardi ex Ubaldi 1995

(= *Luzulo pilosae-Fagetum* (Arrigoni & Nardi 1975) Ubaldi & Speranza 1985 non Celinski & Wika 1977; = "Fagete dell'orizzonte superiore" Arrigoni & Nardi 1975)

Geranio versicoloris-Fagion sylvaticae Gentile 1969

Staphyleo pinnatae-Fagetum sylvaticae Ubaldi & Speranza ex Ubaldi 1995

(= *Cephalanthero-Fagetum apenninum* Ubaldi 1974 *aceretosum obtusati* Ubaldi 1974)

Lathyrus veneti-Fagetum sylvaticae ass. nova

lathyreto-similis subass. nova

carpinetosum betuli subass. nova

Erythronio dentis-canis-Carpinion betuli (Horvat 1958) Marinček in Wallnöfer, Mucina & Grass, 1993

Asparago tenuifolii-Carpinenion betuli Marinček & Poldini 1994

Physospermo-Quercetum petraeae Oberd. & Hof. 1967

Pulmonario apenninae-Carpinenion betuli suball. nova

Centaureo montanae-Carpinetum betuli Ubaldi, Zanotti, Puppi, Speranza & Corbetta ex Ubaldi 1995

centaureetosum montanae subass. nova

arisaretosum proboscidei subass. nova

(= *Arisaro proboscidei-Carpinetum betuli* Ubaldi & Speranza ex Ubaldi 1995)

Erythronio dentis-canis-Quercetum cerridis ass. nova

Carici sylvaticae-Quercetum cerridis Catorci & Orsomando 2001

Fraxino excelsioris-Aceretum obtusati Ubaldi & Speranza ex Ubaldi 1995

polystichetosum setiferi subass. nova

querchetosum cerridis subass. nova

Arisaro proboscidei-Quercetum roboris Blasi *et al.* 2002

Geranio nodosi-Carpinetum betuli Pedrotti, Ballelli & Biondi 1982

Carpino betuli-Coryletum avellanae 1982 Ballelli, Biondi & Pedrotti 1980

Tilio platyphyllo-Acerion pseudoplatani Klika 1955

Aceretum obtusati- pseudoplatani ass. nova

Ornithogalo sphaerocarpi-Aceretum pseudoplatani Taffetani 2000

Quercetalia pubescantis Klika 1933

Ostryo carpinifoliae-Carpinion orientalis Horvat 1956

Laburno anagyroidis-Ostryenion carpinifoliae (Ubaldi 1981) Poldini 1987

Lunario redivivae-Ostryetum carpinifoliae ass. nova

Acknowledgements

We wish to thank Prof. Jesus Izco of the University of Santiago de Compostela (Spain) for the precious information on syntaxonomy.

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Addenda

Tab. 1

Accidental species:

- rel. 1 - *Anemone apennina* L. 1.2, *Cyclamen hederifolium* Aiton +, *Lilium bulbiferum* L. ssp. *croceum* (Chaix) Baker +, *Luzula sylvatica* (Hudson) Gaudin 3.3; rel. 2 - *Rubus idaeus* L. +, *Acer pseudoplatanus* L. +, *Milium effusum* L. +, *Prenanthes purpurea* L. +, *Actaea spicata* L. +, *Neottia nidus-avis* (L.) L. C. Rich. +, *Paris quadrifolia* L. +, *Brachypodium sylvaticum* (Hudson) Beauv. +, *Monotropa hypopitys* L. +, *Salix caprea* L. +, *Lathyrus venetus* (Miller) Wohlf. 1.1, *Epipactis muelleri* Godfery 1.1; rel. 3 - *Corydalis cava* (L.) Schweigg. et Koerte 1.1, *Scilla bifolia* L. 1.1, *Galanthus nivalis* L. +, *Epipactis microphylla* (Ehrh.) Swartz +, *Epipactis gracilis* B. & H. Baumann +, *Mercurialis perennis* L. +, *Melica*

- uniflora* Retz. +, *Luzula forsteri* (Sm.) DC. +; rel. 4 - *Doronicum columnae* Ten. +, *Ranunculus ficaria* L. +, *Helleborus foetidus* L. +; rel. 5 - *Myosotis sylvatica* Hoffm. +; rel. 7 - *Corydalis cava* (L.) Schweigg. & Koerte subsp. *cava* +, *Digitalis lutea* L. +, *Polypodium vulgare* L. +; rel. 9 - *Polygonatum odoratum* (Miller) Druce +.

Locality and date of the relevés:

- rel. 1: Colle gli Scogli (16.05.1998); rel. 2: Poggio del Passino (21.07.1997); rel. 3: M. Cielo (11.07.2001); rel. 4: (rel. 29 of tab. 6 in Ballelli & Biondi, 1982); rel. 5: (rel. 21 of tab. 6 in Ballelli & Biondi, 1982); rel. 6: (rel. 33 of tab. 6 in Ballelli & Biondi, 1982); rel. 7: (rel. 32 of tab. 6 in Ballelli & Biondi, 1982); rel. 8: (rel. 24 of tab. 6 in Ballelli & Biondi, 1982); rel. 9: (rel. 27 of tab. 6 in Ballelli & Biondi, 1982).

Tab. 2

Accidental species:

- rel. 1 - *Aquilegia vulgaris* L. +, *Ruscus aculeatus* L. +, *Helleborus foetidus* L. +, *Crocus napolitanus* Mord. et Loisel. +, *Stellaria media* (L.) Vill. +; rel. 2 - *Taxus baccata* L. +, *Carex digitata* L. +; rel. 3 - *Chaerophyllum temulum* L. +, *Lamium garganicum* L. +, *Aconitum lamarkii* Rchb. +, *Thalictrum aquilegiforme* L. subsp. *aquilegiforme* +; rel. 4 - *Chaerophyllum temulum* L. +, *Lamium garganicum* L. +, *Stellaria media* (L.) Vill. 2.2, *Galium aparine* L. 2.2, *Helleborus foetidus* L. +, *Crocus napolitanus* Mord. et Loisel. +, *Arctium minus* (Hill) Bernh. +; rel. 5 - *Quercus pubescens* Willd. 1.1, *Sambucus nigra* L. 1.1, *Brachypodium sylvaticum* (Hudson) Beauv. 2.2; rel. 6 - *Sympyrum tuberosum* L. +, *Veronica chamaedrys* L. +, *Adenostyles australis* (Ten.) Nyman +, *Anemone nemorosa* L. +, *Cardamine graeca* L. +; rel. 7 - *Digitalis lutea* L. +, *Polypodium vulgare* L. +; rel. 8 - *Myosotis sylvatica* Hoffm. +; rel. 9 - *Rubus caesius* L. 1.2, *Ligustrum vulgare* L. +, *Ornithogalum sphaerocarpum* Kerner +; rel. 10 - *Acer monspessulanum* L. 1.2, *Adenostyles australis* (Ten.) Nyman +, *Phyllitis scolopendrium* (L.) Newman +, *Epilobium montanum* L. +, *Digitalis micrantha* Roth +, *Lamium maculatum* L. +, *Smyrnium perfoliatum* L. +; rel. 12 - *Lamium maculatum* L. 2.2, *Buglossoides purpurea* (L.) Johnston +, *Glechoma hirsuta* W. et K. +; rel. 13 - *Digitalis micrantha* Roth +; rel. 14 - *Smyrnium perfoliatum* L. +, *Ajuga reptans* L. +; rel. 15 - *Polypodium vulgare* L. +; rel. 17 - *Laburnum alpinum* (Miller) Berchtold et Presl 1.1, *Silene dioica* (L.) Clairv. +; rel. 18 - *Silene dioica* (L.) Clairv. +, *Vicia sepium* L. +, *Polystichum aculeatum* (L.) Roth +; rel. 19 - *Carex flacca* Schreber +; rel. 20 - *Rosa canina* L. +, *Dactylorhiza fuchsii* (Druce) Soó +, *Doronicum columnae* Ten. +; rel. 21 - *Rosa canina* L. +, *Cephalanthera rubra* (L.) L.C. Rich. +; rel. 23 - *Cyclamen repandum* S. et S. +.

Locality and date of the relevés:

- rel. 1: M. Marzolare (16.05.1998); rel. 2: M. San Vicino

(18.05.1991); rel. 3: between M. San Vicino and M. Cipollara (20.05.1991); rel. 4: M. Cipollara (25.05.1992); rel. 5: M. Zuccarello (18.05.1996); rel. 6: Colle gli Scigli (31.05.1999); rel. 7, 8: Valle delle Prigioni (06.07.2001); rel. 9: M. Pratizzzo (01.08.2000); rel. 10: M. le Cese (11.07.2001); rel. 11, 12: M. le Cese (07.07.2001); rel. 13: M. Nofegge (11.07.2001); rel. 14: M. le Cese (07.07.2001); rel. 15, 16: Messa Stream (05.05.1999); rel. 17: (rel. 108 of tab. 5 in Ubaldi & Speranza, 1985); rel. 18: (rel. 90 of tab. 5 in Ubaldi & Speranza, 1985); rel. 19: (rel. 81 of tab. 5 in Ubaldi & Speranza, 1985); rel. 20: (rel. 85 of tab. 5 in Ubaldi & Speranza, 1985); rel. 21: (rel. 88 of tab. 5 in Ubaldi & Speranza, 1985); rel. 22: between Cantoniera and Fosso Paolaccio (08.07.2000); rel. 23: between Cantoniera and M. Canale (12.08.2000).

Tab. 3

Accidental species:

rel. 1 - *Mycelis muralis* (L.) Dumort. +, *Arctium nemorosum* Lej. et Court +, *Carex hallerana* Asso +.2, *Galium album* Miller +; rel. 3 - *Hordelymus europaeus* (L.) Harz +; rel. 4 - *Polypodium interjectum* Shivas +, *Fraxinus excelsior* L. 1.2, *Epipactis purpurata* J. E. Smith 1.1, *Polystichum aculeatum* (L.) Roth +; rel. 5 - *Cardamine heptaphylla* (Vill.) O. Schulz +; rel. 6 - *Arctium nemorosum* Lej. et Court +, *Carex pendula* Hudson +, *Thalictrum aquilegfolium* L. subsp. *aquilegfolium* +, *Ulmus glabra* Hudson 1.1; rel. 7 - *Vicia sepium* L. +; rel. 10 - *Malus domestica* Borkh. +, *Dryopteris filix-mas* (L.) Schott +; rel. 11 - *Brachypodium rupestre* (Host) R. et S. +, *Chamaecytisus hirsutus* (L.) Link +, *Molinia arundinacea* Schrank 2.2; rel. 12 - *Chamaecytisus hirsutus* (L.) Link +; rel. 13 - *Veronica chamaedrys* L. +, *Clinopodium vulgare* L. +; rel. 15 - *Brachypodium rupestre* (Host) R. et S. 1, *Vicia sepium* L. +, *Dactylis glomerata* L. +, *Galium mollugo* +; rel. 16 - *Brachypodium rupestre* (Host) R. et S. 1, *Rosa canina* L. sensu Bouleng. +, *Peucedanum cervaria* (L.) Lapeyr. +; rel. 17 - *Brachypodium rupestre* (Host) R. et S. 1, *Rosa canina* L. sensu Bouleng. +, *Fragaria viridis* Duchesne +; rel. 19 - *Rubus ulmifolius* Schott 1, *Brachypodium rupestre* (Host) R. et S. +, *Geum urbanum* L. +, *Veronica chamaedrys* L. +; rel. 20 - *Rubus ulmifolius* Schott 1, *Brachypodium rupestre* (Host) R. et S. +; rel. 21 - *Rubus ulmifolius* Schott 1, *Brachypodium rupestre* (Host) R. et S. +; rel. 22 - *Rubus ulmifolius* Schott +, *Pteridium aquilinum* (L.) Kuhn 1, *Geum urbanum* L. +, *Rosa canina* L. sensu Bouleng. +, *Clematis vitalba* L. +, *Vicia sepium* L. +, *Veronica montana* L. +, *Lamiastrum galeobdolon* (L.) Ehrend. et Polatschek ssp. *flavidum* (F. Hermann) Ehrend. et Pola. +; rel. 23 - *Rubus ulmifolius* Schott +, *Pteridium aquilinum* (L.) Kuhn +, *Clematis vitalba* L. +, *Dactylis glomerata* L. +, *Hypericum androsaemum* L. 1, *Tilia platyphyllos* Scop. 1; rel. 24 - *Clematis vitalba* L. +, *Vicia sepium* L. +; rel. 25 - *Rubus ulmifolius* Schott +, *Pteridium*

aquilinum (L.) Kuhn +, *Rosa canina* L. sensu Bouleng. 1, *Clematis vitalba* L. +, *Rubus hirtus* W. et K. +; rel. 26 - *Rubus ulmifolius* Schott +, *Pteridium aquilinum* (L.) Kuhn +, *Rosa canina* L. sensu Bouleng. 1, *Clematis vitalba* L. +, *Rubus hirtus* W. et K. 2; rel. 27 - *Pteridium aquilinum* (L.) Kuhn +, *Clematis vitalba* L. 1.2, *Arum italicum* Miller +.2, *Allium pendulinum* Ten. 1.2, *Castanea sativa* Miller +.2, *Viola riviniana* Rchb. +, *Paris quadrifolia* L. +; rel. 28 - *Acer monspessulanum* L. 1.1, *Asplenium adiantum-nigrum* L. +; rel. 29 - *Rubus ulmifolius* Schott +, *Silene italica* (L.) Pers. +, *Ranunculus lanuginosus* L. +, *Holcus lanatus* L. +, *Prenanthes purpurea* L. +, *Quercus crenata* Lam. +; rel. 30 - *Rubus ulmifolius* Schott +, *Veronica chamaedrys* L. +, *Silene italica* (L.) Pers. +; rel. 32 - *Brachypodium rupestre* (Host) R. et S. +, *Rosa canina* L. sensu Bouleng. +; rel. 33 - *Veronica officinalis* L. +.2, *Mycelis muralis* (L.) Dumort. 1.1, *Hypericum montanum* L. +, *Senecio fuchsii* Gmelin +, *Clinopodium vulgare* L. +, *Silene italica* (L.) Pers. +, *Cardamine graeca* L. +; rel. 34 - *Pteridium aquilinum* (L.) Kuhn 1.1; rel. 35 - *Senecio fuchsii* Gmelin +, *Clinopodium vulgare* L. +, *Populus tremula* L. 1.2; rel. 36 - *Mycelis muralis* (L.) Dumort. +, *Hypericum montanum* L. +, *Senecio fuchsii* Gmelin +, *Arum italicum* Miller +; rel. 37 - *Pteridium aquilinum* (L.) Kuhn +.2; rel. 38 - *Arum italicum* Miller +; rel. 39 - *Geum urbanum* L. +, *Veronica officinalis* L. +, *Oenanthe pimpinelloides* L. +; rel. 40 - *Geum urbanum* L. +, *Veronica officinalis* L. +, *Mycelis muralis* (L.) Dumort. +, *Hypericum montanum* L. +; rel. 41 - *Geum urbanum* L. +, *Veronica officinalis* L. +, *Pteridium aquilinum* (L.) Kuhn +, *Populus tremula* L. 1.1; rel. 42 - *Pteridium aquilinum* (L.) Kuhn +, *Asplenium onopteris* L. +, *Ribes alpinum* L. +, *Saxifraga rotundifolia* L. 1.2, *Doronicum columnae* Ten. +, *Cytisus sessilifolius* L. +; rel. 43 - *Geum urbanum* L. +, *Epilobium montanum* L. +, *Lonicera etrusca* Santi +, *Luzula sieberi* Tausch 4.5; rel. 44 - *Oenanthe pimpinelloides* L. +, *Cephalanthera rubra* (L.) L.C. Rich. +, *Cardamine graeca* L. +.2, *Luzula sieberi* 3.4.

Locality and date of the relevés:

rel. 1: Cantoniera di Carpegna (26.05.1998); rel. 2, 3: Cantoniera di Carpegna (18.08.2000); rel. 4: Cantoniera di Carpegna (22.07.2000); rel. 5: Cantoniera di Carpegna (10.07.2000); rel. 6: Cantoniera di Carpegna (18.06.1998); rel. 7, 8: Cantoniera di Carpegna (18.08.2000); rel. 9: Pian dei Prati (Carpegna) (01.07.1999); rel. 10: Pian dei Prati (Carpegna) (11.08.2000); rel. 11, 12: Cantoniera di Carpegna (18.08.2000); rel. 13: M. Canale (06.07.2000); rel. 14: between Storena Stream and Ca' la Petra (09.07.2000) rel. 15, 16, 17: (rel. 6, 7, 8 of Tab. 7 in Ubaldi, 1988) southern side of Sasso Simone; rel. 18, 19: (rel. 1, 2 of Tab. 7 in Ubaldi, 1988) Montecopiolo; rel. 20: (rel. 3 of Tab. 7 in Ubaldi, 1988) between Pugliano and Maiolo; rel. 21: (rel. 4 of Tab. 7 in Ubaldi, 1988) Montecopiolo; rel. 22-26: (rel. 1:5 of Tab. 6 in Ubaldi

& Speranza, 1985); rel. 27: San Leo (17/04/1997); rel. 28: San Leo (28.05.1997); rel. 29-32 M. Cerignone, Selva Grossa wood (20.06.2002); rel. 33: (rel. 14 of Tab. 10 in Catorci & Orsomando, 2001) Selvapiana (23.06.1987), rel. 34: (rel. 15 of Tab. 10 in Catorci & Orsomando, 2001) Madonna del Piano (23.06.1987), rel. 35: (rel. 18 of Tab. 10 in Catorci & Orsomando, 2001) Colle d'Aria-Dignano (04.07.1995), rel. 36: (rel. 25 of Tab. 10 in Catorci & Orsomando, 2001) Madonna del Piano (24.06.1995), rel. 37: (rel. 16 of Tab. 10 in Catorci & Orsomando, 2001) Sellano (23.06.1987), rel. 38: (rel. 20 of Tab. 10 in Catorci & Orsomando, 2001) Fonte del Colle-Dignano (27.06.1995); rel. 39: (rel. 17 of Tab. 10 in Catorci & Orsomando, 2001) M. di Cotogna (03.07.1995), rel. 40: (rel. 24 of Tab. 10 in Catorci & Orsomando, 2001) Le Saliere-M. Burella (17.07.1995), rel. 41: (rel. 21 of Tab. 10 in Catorci & Orsomando, 2001) Selva di Cupignolo (03.07.1995), rel. 42: (rel. 19 of Tab. 10 in Catorci & Orsomando, 2001) M. Fietone (27.06.1995); rel. 43-44: (rel. 22-23 of Tab. 10 in Catorci & Orsomando, 2001) Col Falcone (07.07.1995).

Tab. 4

Accidental species:

rel. 1 - *Arum maculatum* L. +, *Mespilus germanica* L. +, *Tamus communis* L. 1, *Teucrium scorodonia* L. +, *Ligustrum vulgare* L. 1, *Prunus spinosa* L. 1, *Galium aristatum* L. 1, *Rhamnus catharticus* L. +, *Fragaria vesca* L. +, *Stachys officinalis* (L.) Trevisan 1, *Clematis vitalba* L. +, *Chamaecytisus hirsutus* (L.) Link +, *Dianthus seguieri* Vill. 1, *Genista germanica* L. +; rel. 2 - *Vinca minor* L. 1, *Luzula pedemontana* Boiss. et Reuter +, *Fagus sylvatica* L. +, *Omphalodes verna* Moench 2, *Hieracium sabaudum* L. +, *Luzula sylvatica* (Hudson) Gaudin +, *Luzula forsteri* (Sm.) DC. +, *Ranunculus nemorosus* DC. +, *Galium aristatum* L. 1; rel. 3 - *Hieracium sylvaticum* (L.) L. +, *Luzula pedemontana* Boiss. et Reuter +, *Luzula nivea* (L.) Lam. et DC. +, *Hieracium sabaudum* L. +, *Luzula sylvatica* (Hudson) Gaudin +, *Luzula forsteri* (Sm.) DC. +, *Ajuga reptans* L. +, *Malus sylvestris* Miller +, *Cephaelanthera longifolia* (Hudson) Fritsch +, *Ranunculus nemorosus* DC. +, *Rhamnus catharticus* L. +, *Silene nutans* L. +; rel. 4 - *Hieracium sylvaticum* (L.) L. +, *Pirus pyraster* Burgsd. +, *Lilium bulbiferum* L. +; rel. 5 - *Vinca minor* L. 2, *Brachypodium rupestre* (Host) R. et S. +, *Phyteuma michelii* All. +; rel. 6 - *Arum maculatum* L. +, *Leucojum vernum* L. +, *Ranunculus ficaria* L. +, *Tamus communis* L. +, *Prunus spinosa* L. +, *Rubus ulmifolius* Schott +; rel. 7 - *Acer platanoides* L. 2, *Sorbus torminalis* (L.) Crantz 1; rel. 8 - *Neottia nidus-avis* (L.) L. C. Rich. +, *Stellaria holostea* L. 2, *Viola mirabilis* L. 1, *Berberis vulgaris* L. 1; rel. 9 - *Campanula persicifolia* L. 1; rel. 12 - *Sorbus torminalis* (L.) Crantz 1; rel. 13 - *Cardamine bulbifera* (L.) Crantz +, *Paris quadrifolia* L. +, *Stellaria holostea* L. 1; rel. 14 - *Viola mirabilis* L. +,

Ligustrum vulgare L. 1; rel. 15 - *Dryopteris filix-mas* (L.) Schott +; rel. 16 - *Dryopteris filix-mas* (L.) Schott 1; *Lonicera xylosteum* L. 1; rel. 17 - *Tilia platyphyllos* Scop. 1.

Locality and date of the relevés:

rel. 1: (Knapp 1953, p. 25, rel. K from tab. 1 in Oberdorfer & Hofmann, 1967) Ceva, on crystalline rocks; rel. 2: (rel. 33 of tab. 1 in Oberdorfer & Hofmann, 1967) south of Acqui-Terme (25/05/1966); rel. 3: (rel. 36 of tab. 1 in Oberdorfer & Hofmann, 1967) Sassello toward Palazzo Bigliatti (25/05/1966); rel. 4: (rel. 13 of tab. 1 in Oberdorfer & Hofmann, 1967) between Acqui-Terme and Sassello (22/04/1965); rel. 5: (rel. 14 of tab. 1 in Oberdorfer & Hofmann, 1967) Foresta Deiva near Sassello, Pian d'Erro (18/04/1965); rel. 6: (rel. 16 of tab. 1 in Oberdorfer & Hofmann, 1967) over Sassello, before Passo Giovo (21/04/1965); rel. 7: (rel. 4 in Poldini, 1985) Percedol; rel. 8: (rel. 11 in Poldini, 1985) Dolina Sator near Storie (YU); rel. 9: (rel. 10 in Poldini, 1985) Volcigrad (YU); rel. 10: (rel. 12 in Poldini, 1985), Coljava-Kosovelo (YU); rel. 11: (rel. 5 in Poldini, 1985) Volcigrada (YU); rel. 12: (rel. 6 in Poldini, 1985) Volcigrad (YU); rel. 13: (rel. 7 in Poldini, 1985) Divaca dolina Risnik (YU); rel. 14: (rel. 8 in Poldini, 1985) Pliskovica (YU); rel. 15: (rel. 9 in Poldini, 1985) Pliskovica (YU); rel. 16: (rel. 13 in Poldini, 1985) dolina Risnik near Divaca (YU); rel. 17: (rel. 14 in Poldini, 1985) at the northern foot of Veliki hrib near Plesivica (YU); rel. 18: (rel. 15 in Poldini, 1985) Rocca di Monrupino; rel. 19: (rel. 16 in Poldini, 1985) Abisso di Fernetti.

Tab. 5

Accidental species:

rel. 1 - *Lapsana communis* L. +, *Pimpinella major* (L.) Hudson +, *Silene alba* (Miller) Krause +, *Glechoma hirsuta* W. et K. +.2; rel. 2 - *Pimpinella major* (L.) Hudson +, *Silene alba* (Miller) Krause +, *Veratrum nigrum* L. +, *Acer monspessulanum* L. +, *Peucedanum verticillare* (L.) Koch +, *Seseli libanotis* (L.) Koch +, *Glechoma hirsuta* W. et K. +.2, *Lapsana communis* L. 1.1; rel. 3 - *Cardamine graeca* L. +, *Alliaria petiolata* (Bieb.) Cavara et Grande +, *Veratrum nigrum* L. +.2, *Delphinium fissum* W. et K. +, *Hieracium laevigatum* Willd. +, *Hypericum montanum* L. +, *Laserpitium latifolium* L. +, *Potentilla micrantha* Ramond +, *Ranunculus nemorosus* DC. +, *Rumex arifolius* All. +, *Asplenium trichomanes* L. +, *Thalictrum aquilegifolium* L. subsp. *aquilegifolium* +, *Galium album* Miller +.2, *Peucedanum austriacum* (Jacq.) Koch 1.1, *Polystichum aculeatum* (L.) Roth +.2, *Corydalis cava* (L.) Schweigg. et Koerte +, *Cardamine enneaphyllos* (L.) Crantz +, *Cardamine bulbifera* (L.) Crantz +; rel. 4 - *Cerastium arvense* L. +; rel. 6 - *Digitalis micrantha* Roth +, *Cornus sanguinea* L. 1.1, *Tilia platyphyllos* Scop. 1.1, *Ulmus glabra* Hudson 2.3, *Bromus ramosus* Hudson 1.2; rel. 7 - *Sesleria italica* (Pamp.) Ujhelyi +, *Sambucus nigra* L.

+, *Rhamnus alpina* L. ssp. *fallax* (Boiss) Maire & Petitmengin
 +, *Cnidium silaifolium* (Jacq.) Simonkai +, *Geranium lucidum*
 L. r, *Ceterach officinarum* DC. r; rel. 8 - *Urtica dioica* L. +,
Alliaria petiolata (Bieb.) Cavara et Grande +, *Chaerophyllum*
temulum L. +, *Prunus spinosa* L. +.2, *Cyclamen repandum* S.
 et S. 1.2, *Euonymus europaeus* L. 1.2, *Glechoma hederacea*
 L. 2.3; rel. 9 - *Cyclamen repandum* S. et S. +, *Acer platanoides*
 L. 1.2, *Ribes uva-crispa* L. 1.2; rel. 10 - *Ribes uva-crispa* L.
 1.2, *Ilex aquifolium* L. +, *Pteridium aquilinum* (L.) Kuhn +,
Stellaria media (L.) Vill. +; rel. 11 - *Epipactis muelleri* Godfery
 +, *Senecio fuchsii* Gmelin +, *Heracleum sphondylium* L. ssp.
ternatum (Velen.) Brummit +; rel. 12 - *Euonymus europaeus*
 L. +, *Viola odorata* L. +.

Locality and date of the relevés:

rel. 1-2: M. Montarone (20.07.2000); rel. 3: M. lo Spicchio
 (08.06.2001); rel. 4: M. Pratizzzo (02.09.1998); rel. 5: Cima
 Filetta (07.08.2000); rel. 6: M. Pratizzzo (02.09.1998) rel. 7:
 under Monte Simoncello (25.08.1999); rel. 8: Sasso di Simone
 (11.08.2000); rel. 9: under Sasso di Simone (11.08.2000); rel.
 10, 11: Cantoniera di Carpegna (22.07.2000); rel. 12: under
 M. Simoncello (22.07.2000).

Tab. 6

Accidental species:

rel. 1 - *Aegopodium podagraria* L. +.2, *Asplenium trichomanes*
 L. +, *Cyclamen repandum* S. et S. 2.3, *Polypodium vulgare*
 L. 1.1, *Crataegus monogyna* Jacq. +, *Ceterach officinarum*
 DC. +, *Veronica hederifolia* L. +.2, *Geum urbanum* L. +,
Luzula forsteri (Sm.) DC. 1.1, *Helleborus foetidus* L. +,
Cruciata glabra (L.) Ehrend. +; rel. 2 - *Clematis vitalba* L.
 12, *Rubus caesius* L. 2.2, *Ligustrum vulgare* L. +, *Polypodium*
interjectum Shivas +.

Locality and date of the relevés:

rel. 1-2: Valleremita (15.11.1996).

Tab. 7

Accidental species:

rel. 1 - *Polypodium vulgare* L. +.2, *Arabis turrita* L. +, *Ruscus*
hypoglossum L. 1.2; rel. 2 - *Rubus hirtus* W. et K.1.2; rel. 4 -
Rubus ulmifolius Schott 1.1.

Locality and date of the relevés:

rel. 1: Le Porte (07.07.2001); rel. 2-3: Valle delle Prigioni
 (06.07.2001); rel. 4: Valle delle Prigioni (02.09.1998).